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**I·B·M Data Processing and  
Computer Programming Course**

**STUDY UNIT II  
LESSON 5-6-7**



# **I.B.M. DATA PROCESSING AND COMPUTER PROGRAMMING**

## **LESSON #5**

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## PREFACE

So far, we have learned what the IBM card is, how it is created, how it is read by people and how it is read by machines. We know that the proper use of IBM machines depends on us — that we have the ability to control these machines by means of control panel wiring so that they provide us with the information we need.

In this lesson and the next, we are going to examine other areas and concepts in control panel wiring which will enable us to more fully develop our ability to use IBM equipment. We are going to study the two most important concepts to be found in I.B.M. Control Panel Wiring: X-Elimination and Selection. In discussing these concepts, we will put to use what we learned in the preceding lesson on the I.B.M. Type 552 Interpreter.



## 5.1 X-Elimination

You remember that in order to distinguish one type of IBM card from another, we make use of a concept called the "control punch." Now, a control punch can be any punch in any column, but the most frequently used control punch is the "x" punch.

For example, in illustrations 1 and 2 we have two cards. They are entirely alike except that the

card in illustration 2 has a control punch in it (an "X" in column 4). You will note that both of these cards are for the same employee number and that they have both been interpreted according to the method of control panel wiring we discussed in Lesson 4. A diagram of the control panel used to interpret these two cards is illustrated in Figure 3.

1234

EMPLOYEE NUMBER	EMPLOYEE NAME	SOCIAL SECURITY NUMBER	WITHOLDING TAX TO OATE	EARNINGS		O.A.B.	BOND				WEEK NO.	U.C.I.
				TO DATE	CURRENT		PRICE	OLD BALANCE	CURRENT CREDIT	NEW BALANCE		
0000	00000000000000000000	0000000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1234	567891011121314151617181920212223	242526272829303132	333435363738	39404142434445	464748495051	5253545556	5758596061	62636465666768	69707172	7374757677787980		
1111	11111111111111111111	1111111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111
2222	22222222222222222222	2222222222	22222222	22222222	22222222	22222222	22222222	22222222	22222222	22222222	22222222	22222222
3333	33333333333333333333	3333333333	33333333	33333333	33333333	33333333	33333333	33333333	33333333	33333333	33333333	33333333
4444	44444444444444444444	4444444444	44444444	44444444	44444444	44444444	44444444	44444444	44444444	44444444	44444444	44444444
5555	55555555555555555555	5555555555	55555555	55555555	55555555	55555555	55555555	55555555	55555555	55555555	55555555	55555555
6666	66666666666666666666	6666666666	66666666	66666666	66666666	66666666	66666666	66666666	66666666	66666666	66666666	66666666
7777	77777777777777777777	7777777777	77777777	77777777	77777777	77777777	77777777	77777777	77777777	77777777	77777777	77777777
8888	88888888888888888888	8888888888	88888888	88888888	88888888	88888888	88888888	88888888	88888888	88888888	88888888	88888888
9999	99999999999999999999	9999999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
1234	567891011121314151617181920212223	242526272829303132	333435363738	39404142434445	464748495051	5253545556	5758596061	62636465666768	697071727374757677787980			

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**Figure 1.**

[illegible]

*Figure 2.*

A NAVAJO INDIAN GIRL  
REPAIRING THE WIRING ON  
AN IBM ACCOUNTING MACHINE  
SO IT CAN PERFORM A NEW  
JOB.









Figure 6 is a schematic of the X-Eliminator circuit.

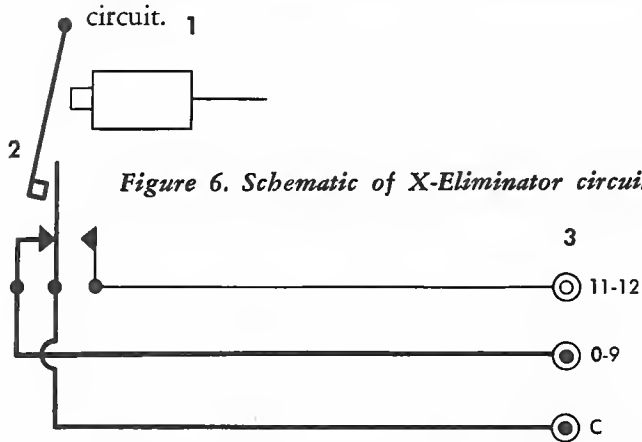


Figure 6. Schematic of X-Eliminator circuit.

There are three parts to the X-Eliminator circuit.

1. The magnet, which at any time will be either energized or de-energized.
2. An Armature: If the magnet is energized, it will draw the armature towards it and establish a contact. If the magnet is de-energized (as it is in this schematic), there will not be a contact between the armature and the magnet.
3. Control panel hubs — these are internally connected to the corresponding hubs on the face of the panel.

Now refer to Figure 7.

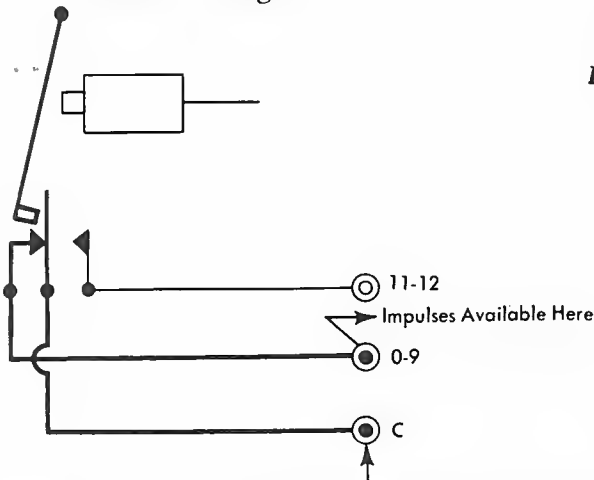


Figure 7.

Wired from Brushes — All Punches 9-12

Flow of impulses from reading brushes for 0-9 punches.

In this illustration, the magnet is de-energized. Should we now direct an impulse (from a reading brush) into the "C" hub of this X-Eliminator, that same impulse would be available from the 0-9 hub of the X-Eliminator. Trace the path of

this impulse as it enters the "C" hub. At this point, it appears that all impulses that enter the "C" hub from the reading brush will be available at the 0-9 hub. However, let me introduce one more fact.

For every machine cycle, the Interpreter emits an internal impulse *at the time the brushes are reading the 12 and 11 zones*. This impulse is directed to the magnets which are part of the X-Eliminator circuits. What is the result of this internal impulse? Refer to Figure 8.

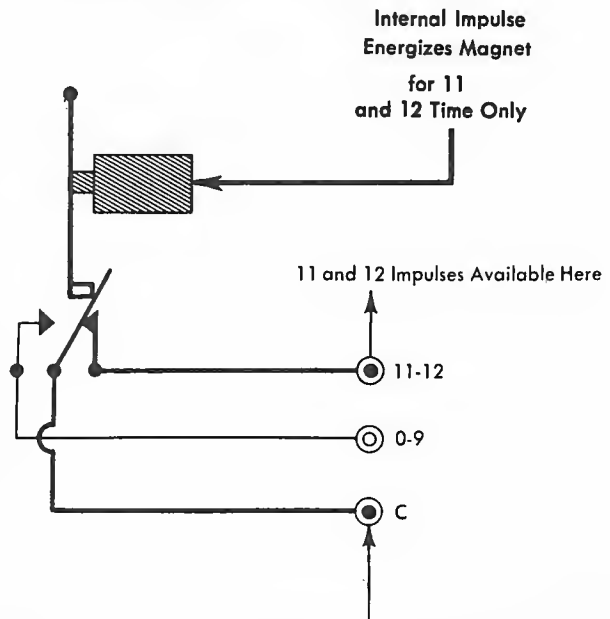


Figure 8.

Wired from Brushes — All Punches 9-12

Flow of impulses from reading brushes for 11 & 12 punches.

1. The internal impulse energizes the magnet at the time the 12 and 11 zones are being read.
2. Energizing the magnet causes the armature to transfer its position and establishes a contact with the 11-12 hub.
3. After the 11 zone has been read, the magnet will be de-energized and the X-Eliminator circuit will appear as Figure 7.

The X-Eliminator permits us to split a column into the two segments discussed earlier: the 12 and 11 segment; and the 0-9 segment. All impulses are read by the reading brush and directed to the "C" hub of the X-Eliminator. The 12 and 11 impulses are then available from the "11-12" hub; and the 0-9 impulses are available from the "0-9" hub. Let us look at an adjusted control panel diagram for the problem illustrated at the beginning of this lesson.

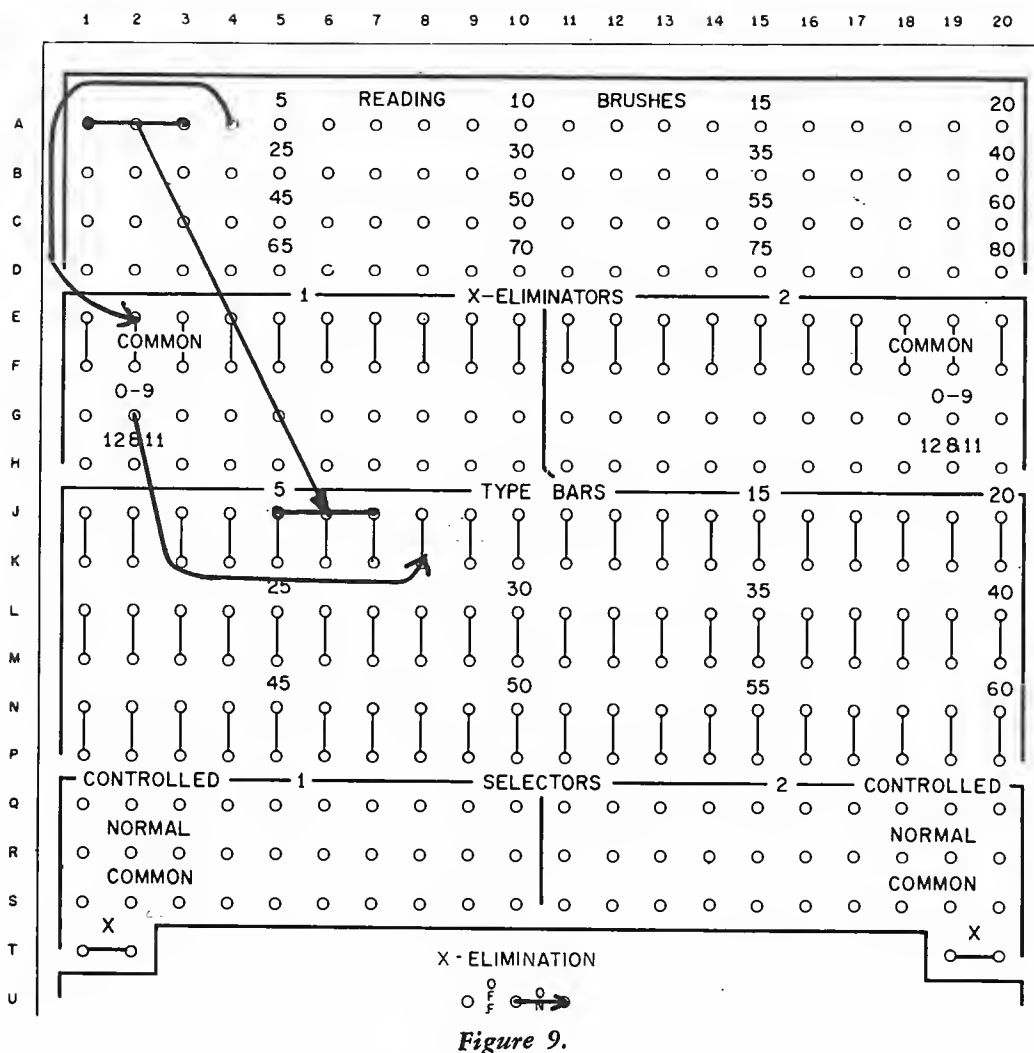


Figure 9.

Examine this illustration in conjunction with illustrations 10 and 11.

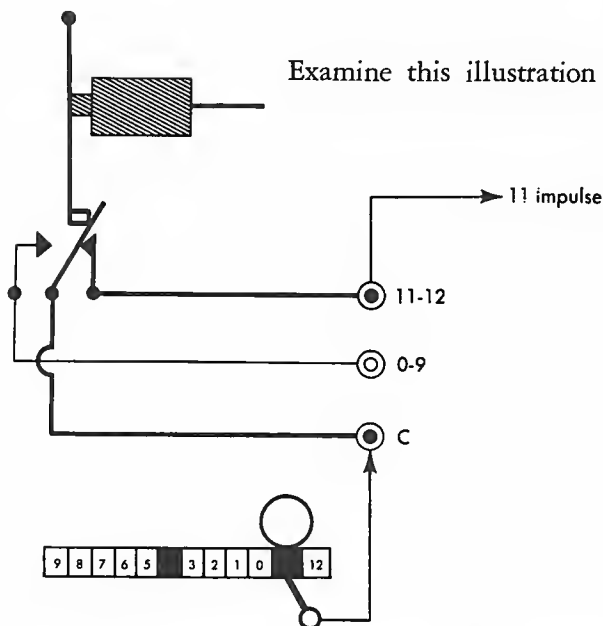


Figure 10. X-Eliminator schematic at 11-12 time.

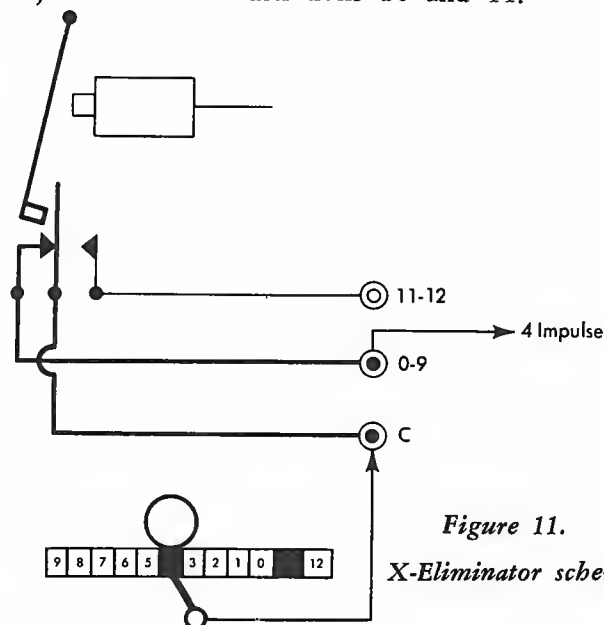


Figure 11.

X-Eliminator schematic at 0-9 time.

1. Card columns 1-3 contain only numeric information, so they are wired routinely.
2. Card column 4 contains a digit which is part of the employee number and an "X"

punch which is used as a control punch. We do not want to use this "X" punch as part of our interpreting routine.

3. Reading brush 4 is wired to the "C" hub of X-Eliminator 2. Notice that there are two groups of X-Eliminators, each group containing 10 X-Eliminator circuits. We are using X-Eliminator 2 although we could have used any one of the first ten. The first ten are standard and will be found on any Type 552 Interpreter. Numbers 11-20 are optional and can be installed if required.
4. The impulses read from brush 4 will enter the "C" hub of X-Eliminator 2. As the "X" punch in the card is being read, the magnet is energized internally and the "X or 11" impulse is available from the 11-12 hub. Since we have no use for this impulse in our problem, we do not wire the 11-12 hub.
5. When the 4 impulse reaches the "C" hub, the magnet is de-energized and the 4 im-

pulse is available from the 0-9 hub of the X-Eliminator. From there it is taken to the selected typebar.

6. What we have accomplished in effect is that we have "detoured" the X impulse so that it did not reach the typebar. All that we have permitted to reach the typebar is the impulse for the digit 4 and this is what will be printed.
7. In order to activate the X-Eliminators (to cause the machine to internally emit a magnetizing impulse when the 12 and 11 zones are being read), we wire the X-Eliminator switch ON (Row U, hubs 10-11).

#### Sample Problem:

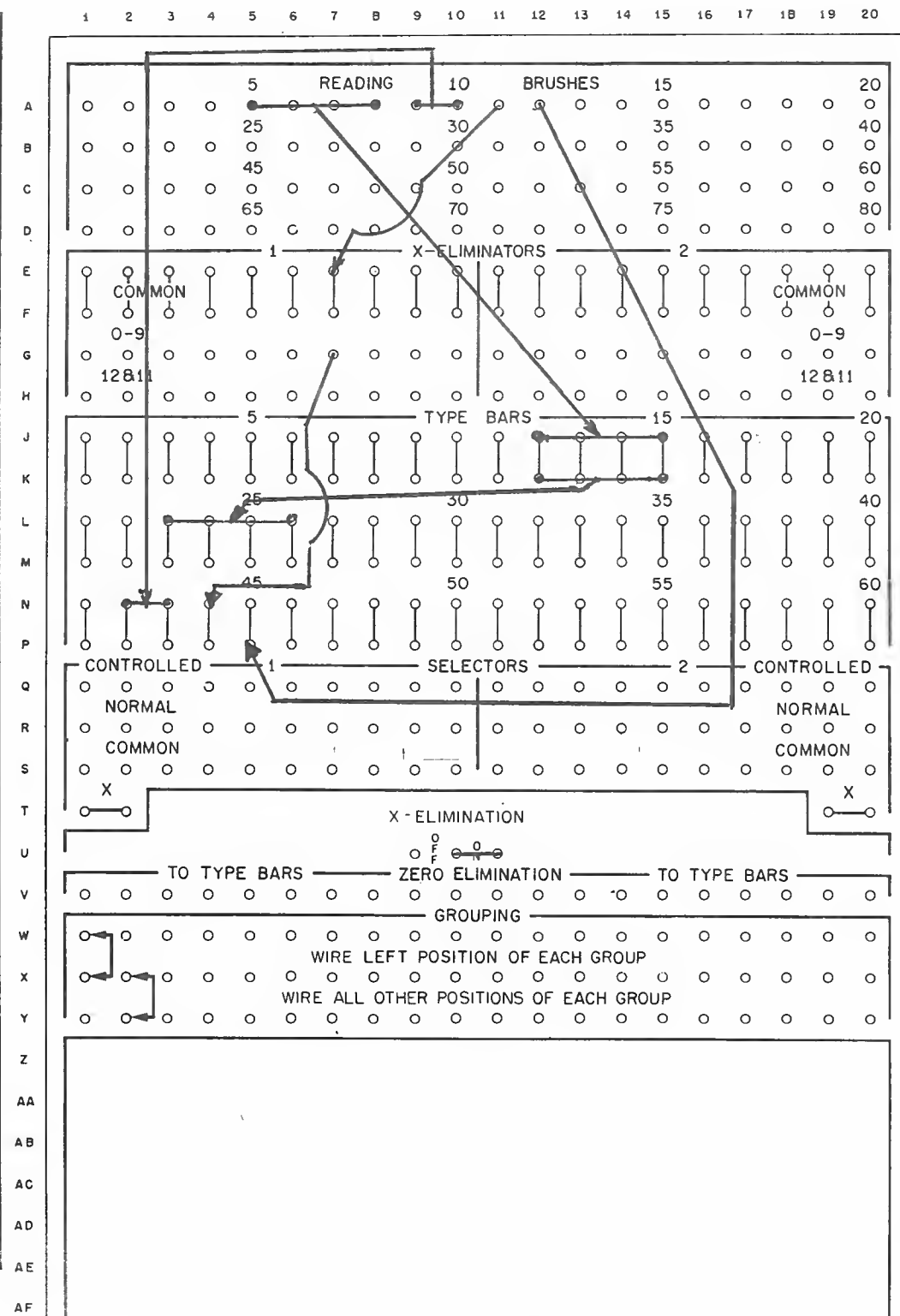
Wire c.c. 5-8 to t.b. 12-15 and to t.b. 23-26

Wire c.c. 9-12 to t.b. 42-45, eliminate X-11

See Figure 12 for correct solution.





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## PRINTING POSITIONS

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Page 9

### 5.3 Exercises

Diagram your solution on the blank control panel diagrams to be found on the next few pages.

1. Wire c.c. 18-22 to t.b. 1-5. Eliminate X-22
2. Wire c.c. 3-4 to t.b. 21-22 and t.b. 23-24  
Wire c.c. 5-8 to t.b. 28-31. Eliminate X-5

Check your answers with the solutions at the back of the lesson.

3. Wire c.c. 25-45 to t.b. 30-50  
Wire c.c. 1-4 to t.b. 22-25. Eliminate X-4
4. Wire c.c. 7-10 to t.b. 7-10  
Wire c.c. 12-15 to t.b. 21-24.  
Eliminate X-15  
Wire c.c. 76-80 to t.b. 54-58.  
Eliminate X-80
5. Wire c.c. 67-70 to t.b. 1-4  
Wire c.c. 14-25 to t.b. 7-18  
Wire c.c. 72 to t.b. 20 and t.b. 60.  
Eliminate X-72  
Wire c.c. 33-35 to t.b. 23-25.  
Eliminate X-33

Check your answers with the solutions at the back of the lesson.

### GLOSSARY

*Common Hub*—The hub that is common (linked to) other hubs of the X-Eliminator at any time.

*Column Split*—Same as the X-Eliminator.

*Internal Impulse*—An electrical impulse which is provided by the machine at certain times in the cycle. In the case of the X-Eliminator, this internal impulse is emitted by the machine at that time in the cycle when the 12 and 11 zones are being read.

*X-Eliminator*—A device within IBM machines which permits us to split a column into two sections as the card is being read: 0-9 impulses and 11 & 12 impulses.

*0-9 Hub*—For each card cycle, the 0-9 hub is connected with the Common hub at the time the zones 0-9 are being read. Only 0-9 impulses being read from the card and directed into the Common hub will be available from the 0-9 hub.

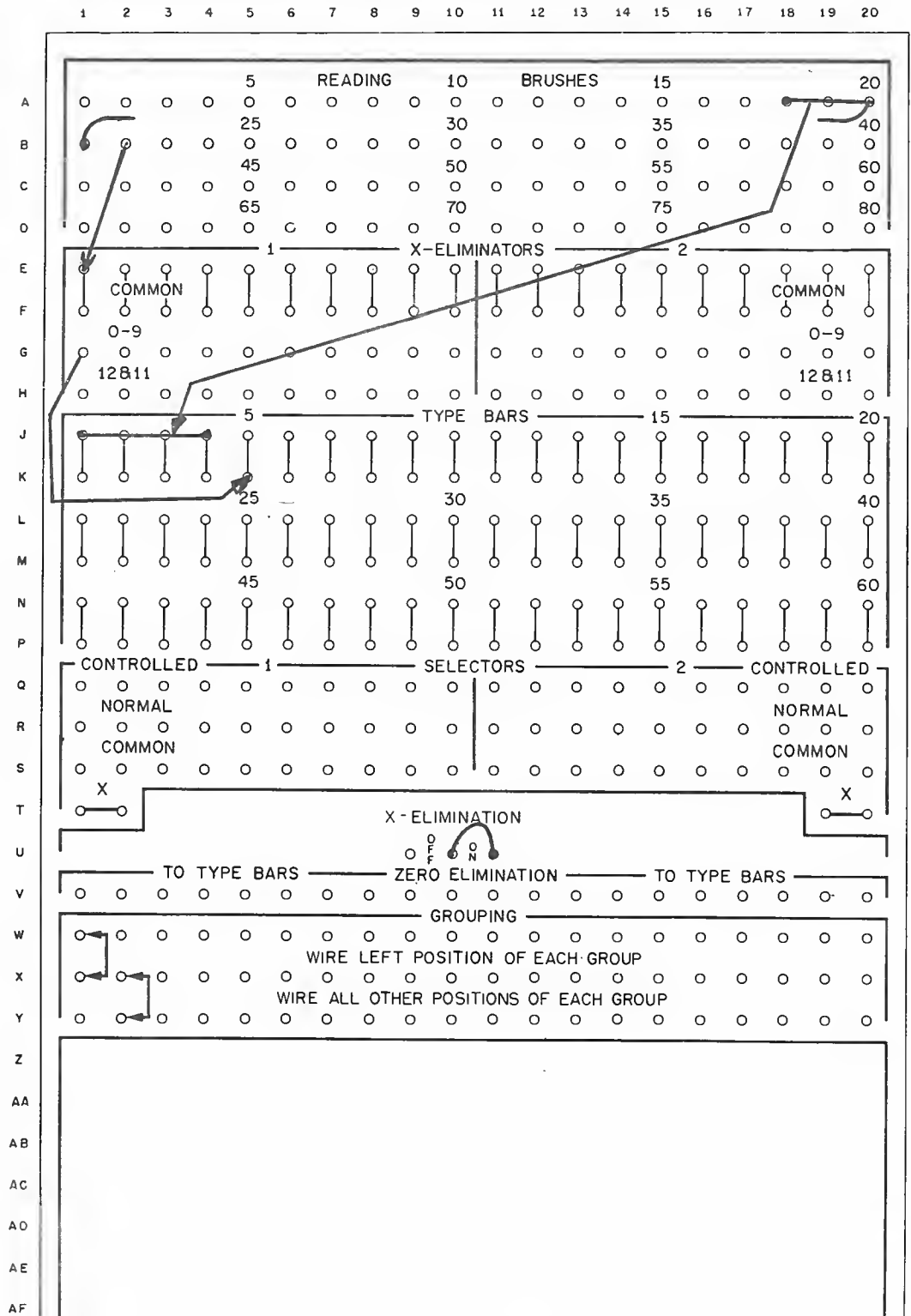
*11-12 Hub*—For each card cycle, the 11-12 hub is connected with the Common hub at the time the 11 & 12 zones are being read. Only 11 & 12 impulses being read from the card and directed into the Common hub will be available from the 11-12 hub. Usually, these 11 & 12 punches in the card are control punches which we want to prevent from reaching the typebar.

Note that the 11 & 12 hub is never connected with the 0-9 hub.



# IBM 552 CONTROL PANEL

NOTES:					
X OR D CODE					
CARD NAME OR FUNCTION					
ELECTRO NO.					



DEPT.

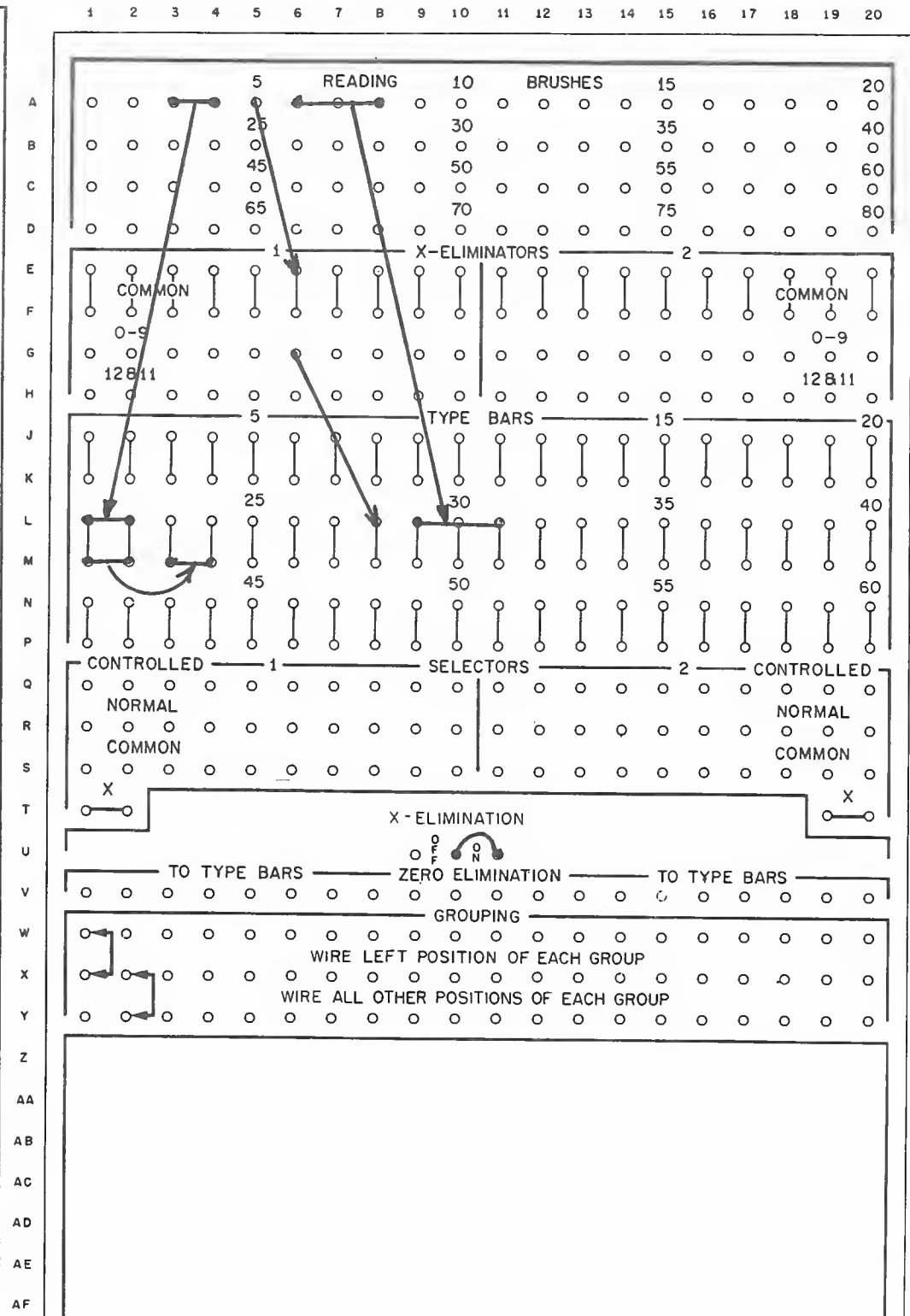
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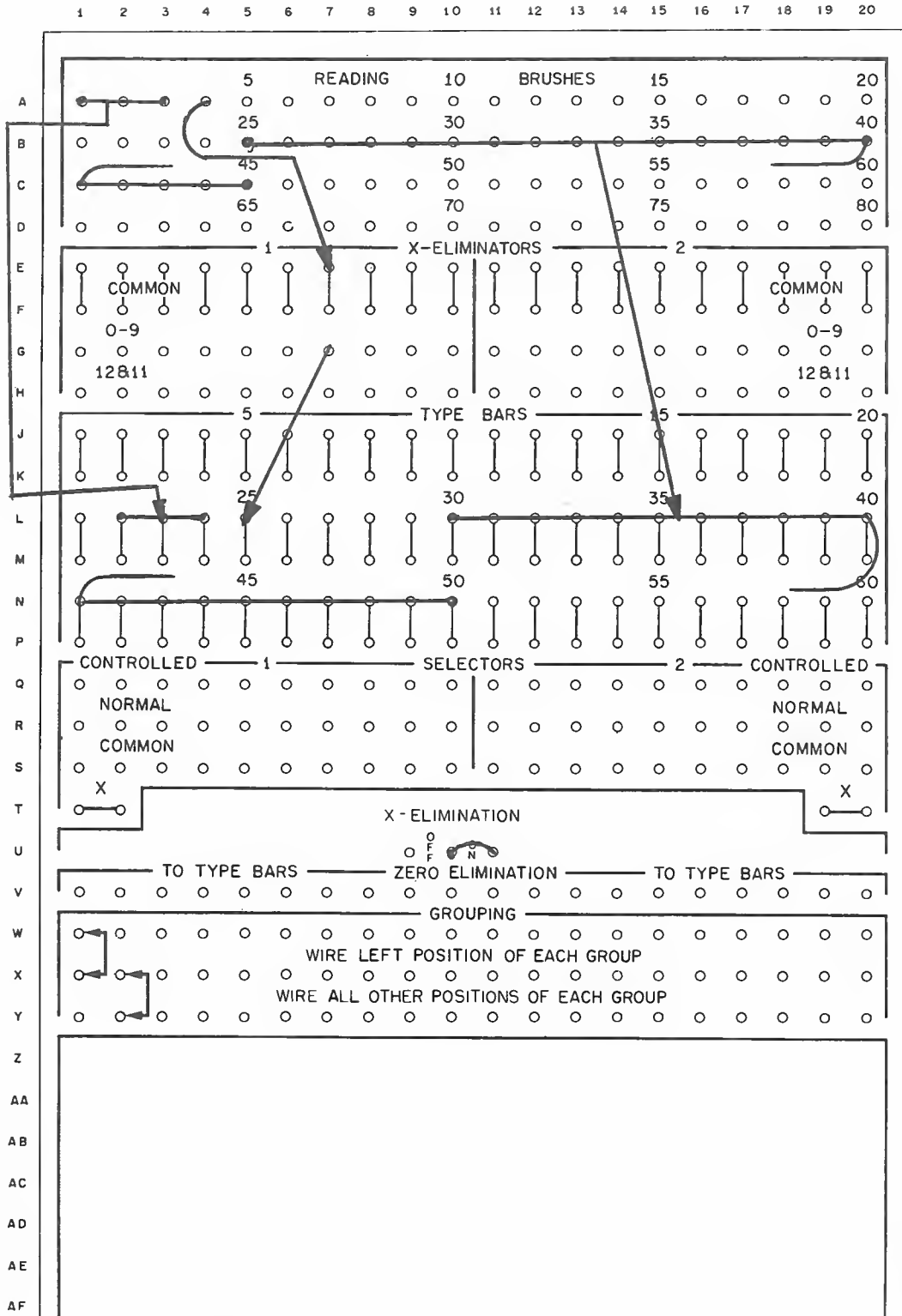
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## IBM 552 CONTROL PANEL

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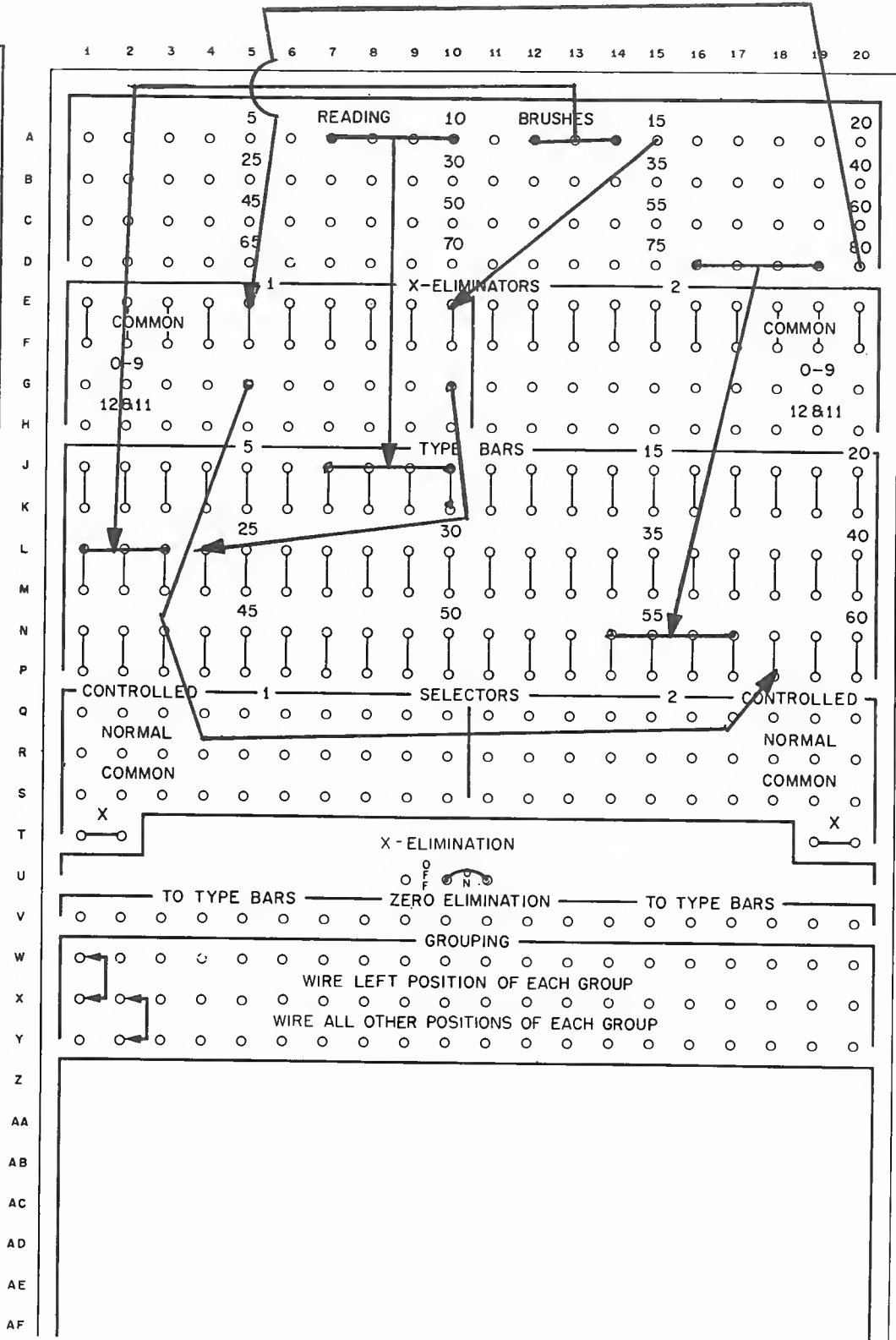
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# IBM 552 CONTROL PANEL

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CARD NAME OR FUNCTION					
X OR D CODE					
NOTES:					



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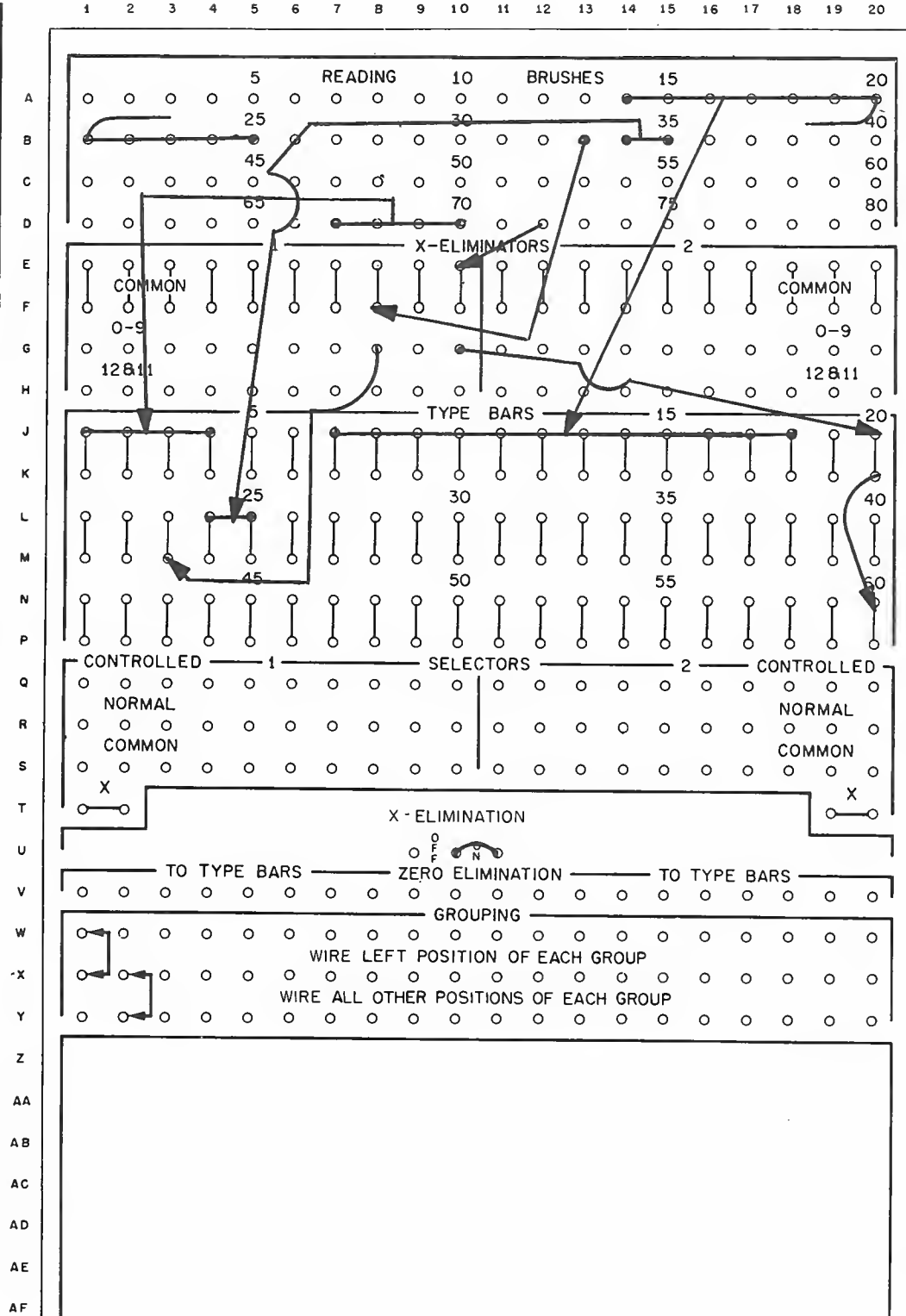
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## PRINTING POSITIONS

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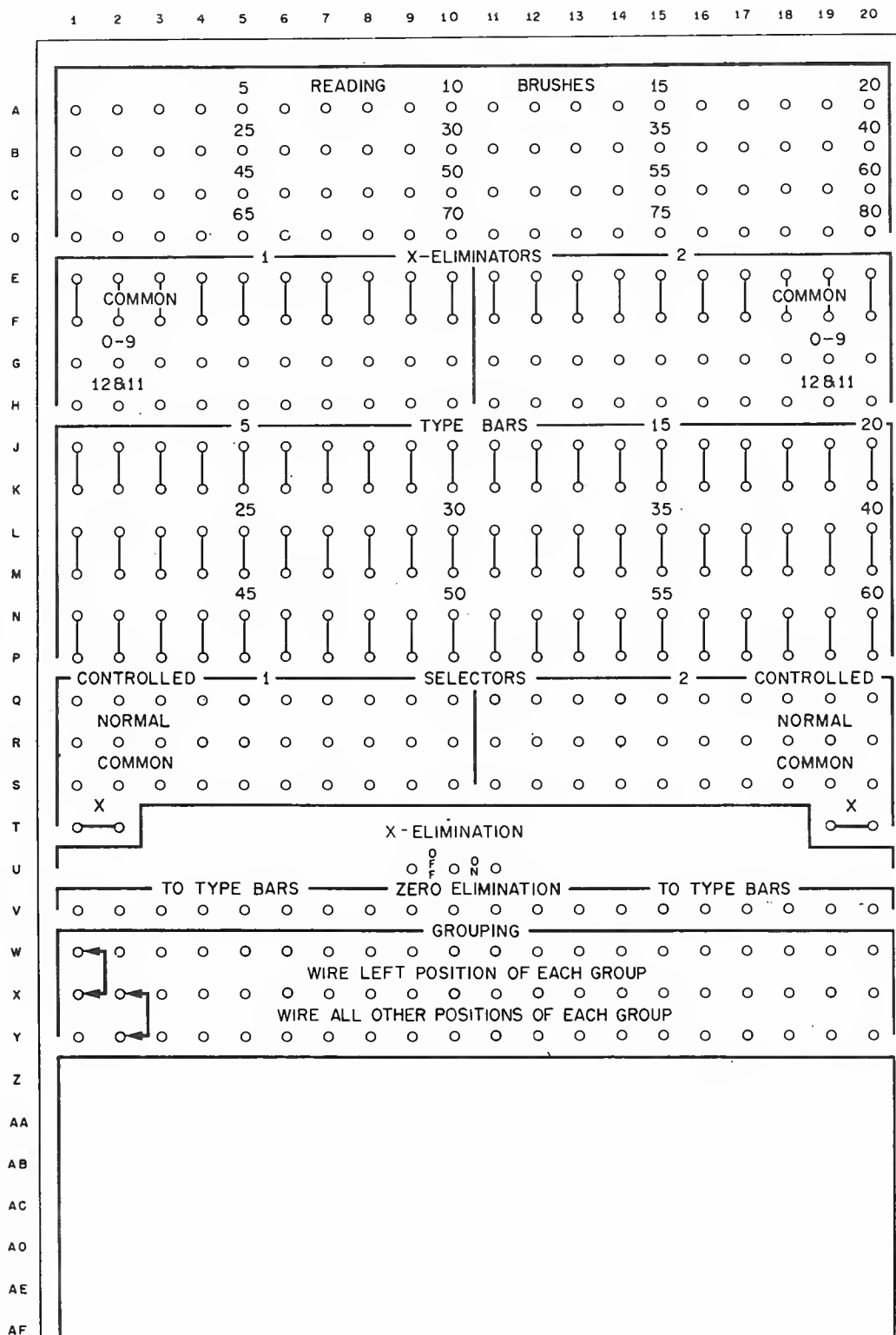
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	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	○	○	○	○	5		READING		10		BRUSHES		15							20
B	○	○	○	○	25				30				35							40
C	○	○	○	○	45				50				55							60
D	○	○	○	○	65				70				75							80
E	1 ——— X-ELIMINATORS ———										2 ———									
F	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
G	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
H	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
I	5 ——— TYPE BARS ———										15 ——— 20									
J	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
K	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
L	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
M	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
N	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
O	CONTROLLED ——— 1 ——— SELECTORS ———										2 ——— CONTROLLED									
P	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Q	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
R	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
S	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
T	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
U	X - ELIMINATION																			
V	TO TYPE BARS ———										TO TYPE BARS ———									
W	GROUPING																			
X	WIRE LEFT POSITION OF EACH GROUP																			
Y	WIRE ALL OTHER POSITIONS OF EACH GROUP																			
Z																				
AA																				
AB																				
AC																				
AD																				
AE																				
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B	○	○	○	○	25				30				35							40				
C	○	○	○	○	45				50				55							60				
D	○	○	○	○	65				70				75							80				
E					1	X-ELIMINATORS										2								
F	○	○	○	○	COMMON	○	○	○	○	○	○	○	○	○	○	○	○	○	○	COMMON				
G	○	○	○	○	0-9	○	○	○	○	○	○	○	○	○	○	○	○	○	○	0-9				
H	○	○	○	○	12811	○	○	○	○	○	○	○	○	○	○	○	○	○	○	12811				
J					5	TYPE BARS										15								
K	○	○	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	○					
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M	○	○	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	○					
N	○	○	○	○	45				50				55							60				
P	○	○	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	○					
Q	CONTROLLED				1	SELECTORS										2	CONTROLLED							
R	○	○	○	○	NORMAL	○	○	○	○	○	○	○	○	○	○	○	○	○	○	NORMAL				
S	○	○	○	○	COMMON	○	○	○	○	○	○	○	○	○	○	○	○	○	○	COMMON				
T	○	○	○	○	X	X-ELIMINATION														○	○	○	○	X
U						ZERO ELIMINATION																		
V	TO TYPE BARS																TO TYPE BARS							
W	GROUPING																							
X	WIRE LEFT POSITION OF EACH GROUP																							
Y	WIRE ALL OTHER POSITIONS OF EACH GROUP																							
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# IBM 552 CONTROL PANEL

NOTES:					
X OR D CODE					
CARD NAME OR FUNCTION					
ELECTRO NO.					

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A					5		READING		10		BRUSHES		15							20
B					25				30				35							40
C					45				50				55							60
D					65				70				75							80
E						1					X-ELIMINATORS				2					
F					COMMON														COMMON	
G					0-9														0-9	
H					12811														12811	
J						5					TYPE BARS				15					20
K																				
L					25				30				35							40
M																				
N					45				50				55							60
P																				
Q						1					SELECTORS				2					
R					NORMAL														NORMAL	
S					COMMON														COMMON	
T					X															X
U											X-ELIMINATION									
V																				
W																				
X																				
Y																				
Z																				
AA																				
AB																				
AC																				
AD																				
AE																				
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## PRINTING POSITIONS

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

# IBM 552 CONTROL PANEL

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
NOTES:																					
X OR D CODE																					
CARD NAME OR FUNCTION																					
ELECTRO NO.																					

A						5	READING					10	BRUSHES					15						20	
B						25						30						35						40	
C						45						50						55						60	
D						65						70						75						80	
E						1 X-ELIMINATORS 2																			
F						COMMON															COMMON				
G						0-9															0-9				
H						12&11															12&11				
J						5	TYPE BARS					15						20							
K						25						30						35						40	
L						45						50						55						60	
M																									
N																									
P																									
Q						CONTROLLED 1 SELECTORS 2 CONTROLLED																			
R						NORMAL															NORMAL				
S						COMMON															COMMON				
T						X															X				
U						X - ELIMINATION																			
V						TO TYPE BARS										ZERO ELIMINATION					TO TYPE BARS				
W						GROUPING																			
X						WIRE LEFT POSITION OF EACH GROUP																			
Y						WIRE ALL OTHER POSITIONS OF EACH GROUP																			
Z																									
AA																									
AB																									
AC																									
AD																									
AE																									
AF																									

DEPT.

NO.

NAME

USE

## PRINTING POSITIONS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
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# IBM 552 CONTROL PANEL

NOTES:					
X OR D CODE					
CARD NAME OR FUNCTION					
ELECTRO NO.					

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
A					5	READING				10	BRUSHES				15					20				
B					25					30					35					40				
C					45					50					55					60				
D					65					70					75					80				
E					X-ELIMINATORS																			
F	COMMON																				COMMON			
G	0-9																				0-9			
H	12&11																				12&11			
J					5	TYPE				15	BARS				15					20				
K					25					30					35					40				
L					45					50					55					60				
M																								
N																								
P																								
Q	CONTROLLED				SELECTORS																CONTROLLED			
R	NORMAL																				NORMAL			
S	COMMON																				COMMON			
T	X																				X			
U					X-ELIMINATION																			
V					TO TYPE BARS																TO TYPE BARS			
W					GROUPING																			
X					WIRE LEFT POSITION OF EACH GROUP																			
Y					WIRE ALL OTHER POSITIONS OF EACH GROUP																			
Z																								
AA																								
AB																								
AC																								
AD																								
AE																								
AF																								

DEPT.

NO.

NAME

USE

## PRINTING POSITIONS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

## EXAMINATION

**INSTRUCTIONS:** Your examinations are important to you as they indicate how well you understand the lesson material. Be sure to allow yourself enough time to complete the examination. Read each question carefully and be sure you understand it. Mark your answers in the proper box. Review the exam to be sure that all questions have been answered.

1. The X-Eliminator hub which is always internally connected to one of the other X-Eliminator hubs is the:
  - a) 0-9 hub
  - b) C hub
  - c) 11-12 hub
  - d) none of the above
2. The two X-Eliminator hubs which are never internally connected are the:
  - a) C and 11-12 hub
  - b) C and 0-9 hub
  - c) 0-9 and 11-12 hub
  - d) none of the above
3. The X-Eliminator circuits are active:
  - a) On every card cycle
  - b) Only for those card cycles where 11 or 12 punches are read
  - c) Only for those card cycles where 0-9 punches are read
  - d) On every card cycle provided the X-Elimination switch is wired ON.
4. An internal impulse is emitted:
  - a) While the 0-9 zones are being read
  - b) For all zones being read
  - c) For the X zone only
  - d) While the 11 & 12 zones are being read
5. Which of the following statements is true:
  - a) The X-Eliminator magnet is energized during 0-9 time
  - b) There is an internal connection between the C and 0-9 hubs at the time the 11-12 zones are being read
  - c) All 20 X-Eliminators are standard
  - d) There is an internal connection between the C and 0-9 hubs while the 0-9 zones are being read

Refer to the diagram called Figure 13 and answer the following questions True or False.

If True mark Box A; if False, mark Box B.

6. Assume that c.c. 2-5 are punched 657M. (The letter M is a combination of an X and a 4•punch). The machine would print 6574 from t.b. 2-5.
7. Assume that c.c. 2-5 are punched M657. The machine would print 4657 from t.b. 2-5.
8. Assume that c.c. 2-5 are punched M65M. The machine would print 4654 from t.b. 2-5.
9. Assume that c.c. 2-5 are punched M65M. The machine would print M654 from t.b. 2-5.
10. Assume that c.c. 11-15 are punched M2345. The machine would print M2345 in t.b. 13-17 and 42345 in t.b. 33-37.
11. Assume that c.c. 11-15 are punched M2345. The machine would print 42345 in t.b. 13-17 and M2345 in t.b. 33-37.
12. Assume that c.c. 11-15 are punched M2345. The machine would print 42345 in t.b. 13-17 and 42345 in t.b. 33-37.
13. Assume that c.c. 11-15 are punched 6382M. The machine would print 63824 in t.b. 13-17 and 6382M in t.b. 33-37.
14. Assume that c.c. 11-15 are punched 6382M. The machine would print 6382M in t.b. 13-17 and 6382M in t.b. 33-37.
15. Assume that c.c. 11-15 are punched 63M82. The machine would print 63M82 in t.b. 13-17 and 63M82 in t.b. 33-37.

# IBM 552 CONTROL PANEL

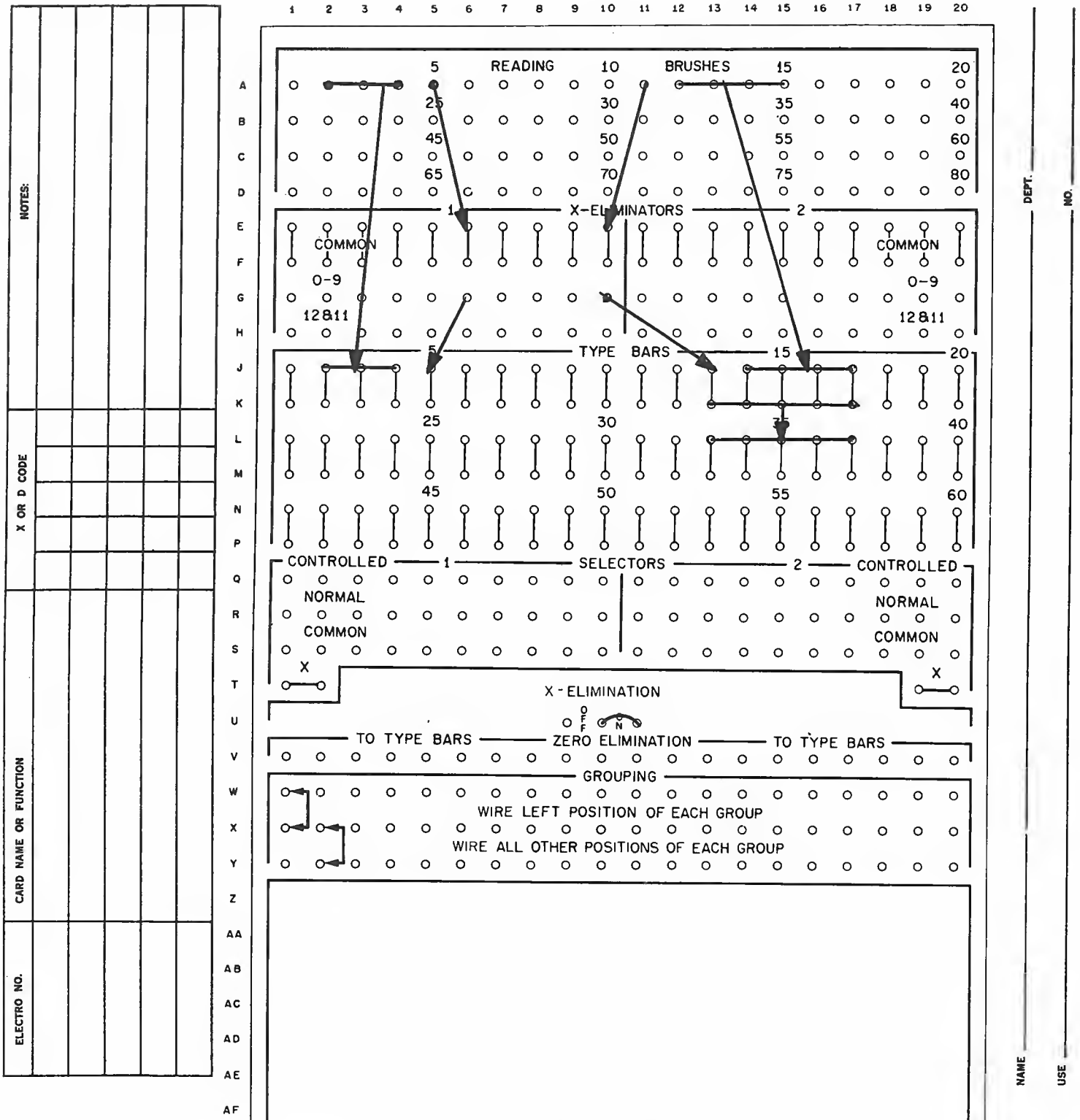


Figure 13.



# **I.B.M. DATA PROCESSING AND COMPUTER PROGRAMMING**

## **LESSON #6**

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#### **6.1) Selection**

**Basic concepts, problems and exercises**

#### **6.2 Types of Selection**

**Field and Class selection;**

**Glossary**

**Examination**

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## 6.1 Selection

Selection is the IBM method of enabling a machine to make a decision. For example, there may be times when interpreting cards that we want to print on certain types of cards only. We would, first of all, need a method whereby the machine can distinguish between types of cards. Well, we have such a method — the use of control punches. There may also be times when we want to print a given field on the left side of some cards and on the right side of others.

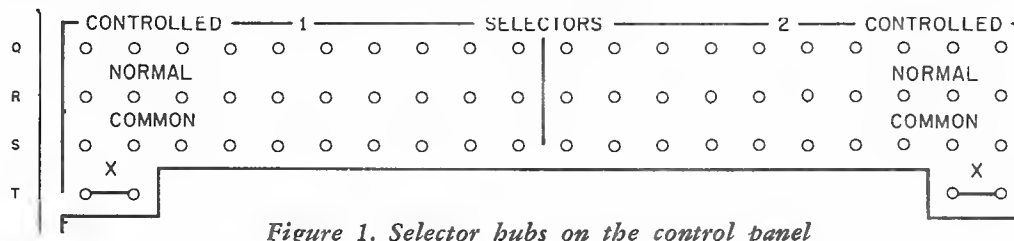


Figure 1. Selector hubs on the control panel

Before we discuss the use of selectors, let us study the theory behind the use of this concept. You will notice in Figure 1 that there are 20 vertical sets of three hubs each in the selectors illustrated. The bottom row is called "Common"; the middle row is called "Normal"; and the top row is called "Controlled." Once we learn the function of any one of these 20 sets, we will understand all of them, just as once you understand how one X-Eliminator works, you can use any of them.

Figure 2 is a schematic of the basic selector showing the three hubs: Common (C); Normal (N); and Controlled (T). The letter T used in indicating the Controlled hub is the accepted abbreviation for the word "Transferred," which is a synonym for Controlled in IBM language.

Notice that the basic selector schematic is very much like the schematic for the X-Eliminator. We have the same three parts: the magnet, armature and three hubs. There is however, one basic difference.

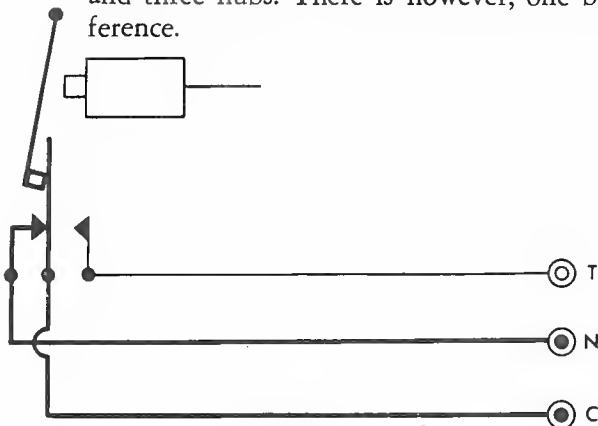


Figure 2.

Schematic of basic selector in Normal condition.

Again, if we can distinguish between types of cards (by control punches) we can direct the machine, through proper control panel wiring to give us precisely the results we want.

The device used to permit us to make a decision with an IBM machine is called a Selector. Two selectors are available with the 552 Interpreter. Their location on the control panel is immediately below the type bars. Figure 1 illustrates the Selector portion of the control panel.

The magnet which is part of the X-Eliminator is energized automatically every card cycle, during the time that 12 and 11 punches are being read, by an impulse which is generated internally by the Interpreter. In other words, we do not, by control panel wiring, direct an impulse to the magnet.

When using a selector, on the other hand, we do, by control panel wiring, decide when the magnet is to receive an impulse which will cause it to "Transfer" and pull the armature towards it.

A selector is said to be in one of two conditions at any time.

1. If the magnet is de-energized, the selector is said to be NORMAL. In this condition, there is an internal connection between the "C" and the "N" hubs. (See Figure 2.)
2. If the magnet is energized, the selector is said to be TRANSFERRED OR CONTROLLED. In this condition, there is an internal connection between the "C" and "T" hubs. (See Figure 3.)

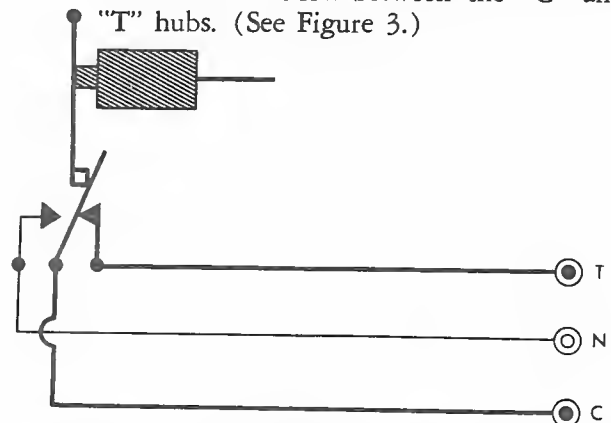


Figure 3.

Schematic of basic selector in Transferred condition.

The next question is: How do we cause the selector to Transfer? Or, to put the question in other words: How do we cause the selector magnet to be energized?

Refer to Figure 1 once again. On line T, hubs 1 & 2 and also hubs 19 & 20 are marked "X". These are referred to as "X" Pickup hubs. X-Pickup hubs are unique in that they will not recognize or accept any impulse but an impulse generated at "X" time (the time an X is being read by the reading brushes). The X-Pickup hubs are in turn connected internally to the selector magnets. Let us refer to Figures 4 and 5 below and see if we can visualize what happens internally as a selector transfers.

Assume that column 21 has been designated as the column to contain an X control punch. This means that some of the cards being interpreted have an X punch in column 21 and others do not.

1. Assume that the first card passing through the machine is a NX card (this means No X in Column 21). The condition of the selector at this time is Normal. Therefore, wiring a reading brush impulse from a column into the Common hub of the selector will cause the same impulse to come out of the Normal hub. (See Figure 4.)

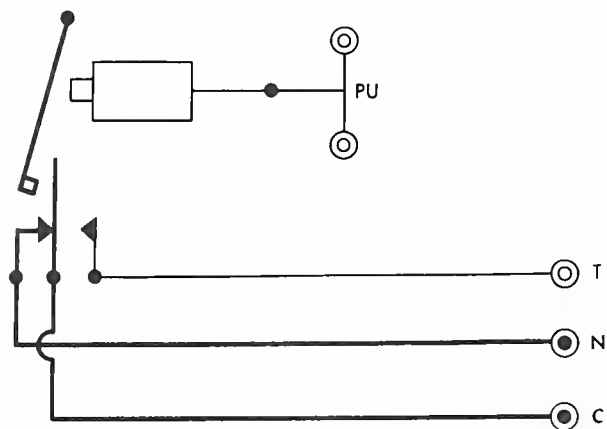


Figure 4. Selector and X-Pickup hubs in Normal condition.

2. Now assume that the next card passing through the machine is an X card (this means it has an X punch in Column 21.) This X punch enters the X-Pickup hub of the selector; from there it reaches and energizes the magnet. As the balance of the card is being read, the selector is in a Transferred condition and the reading brush impulse from a column into the Common hub of the selector comes out of the Transferred hub. (See Figure 5).

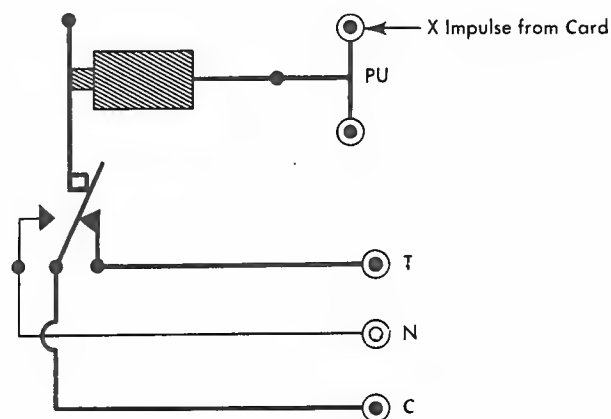


Figure 5.

*Selector and X-Pickup hubs in Transferred condition.*

3. The selector will always "drop out", return to a Normal condition, at the end of each card cycle.
4. When the X-Pickup hub of a selector receives an X impulse, all ten positions of that selector transfer at the same time. Note that there are ten vertical rows of three hubs each for each of the two selectors. Each selector is independent of the other and it is possible for selector 1 to be in a Transferred condition for a card and for selector 2 to be in a Normal condition for the same card.

Problem: Let us study the solution to a basic selector problem which will illustrate the principles discussed so far.

We have a deck of cards in which there are some X-78 cards. The X-78 cards have already been in-

terpreted. Our job is to run the deck of cards through the interpreter and print on only the NX 78 cards. We want to print column 5 in typebar 18, and columns 12-13 in typebars 45-46. Figure 6 illustrates the control panel diagram to do this job.

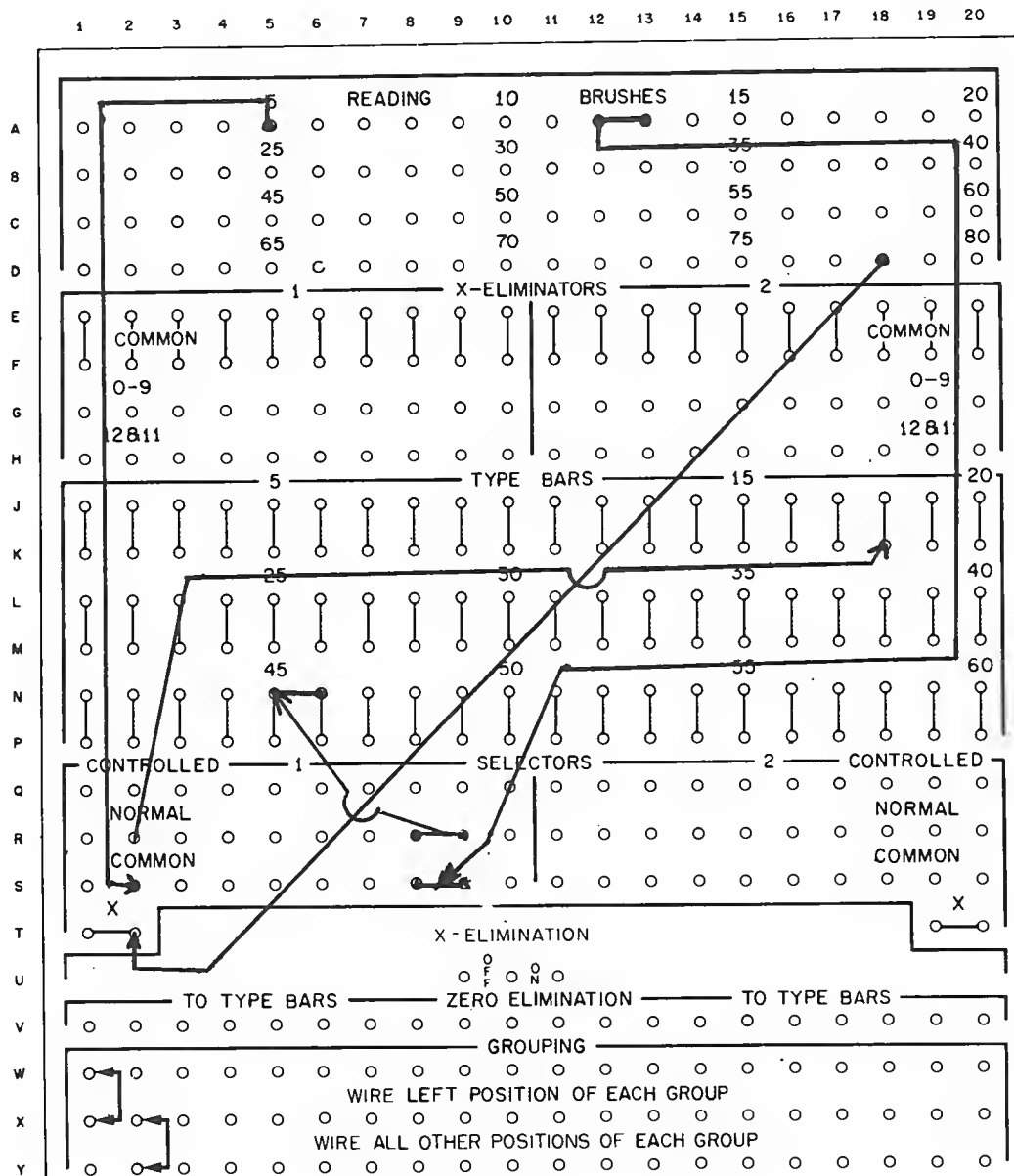


Figure 6.

## Notes on Figure 6:

1. When NX 78 cards are being processed:
  - a) The X pickup hub of the selector *does not* receive an impulse; therefore, the selector is Normal and impulses which enter the Common hubs from the reading brushes come out of the Normal hubs and reach the typebars.
2. When X 78 cards are being processed:
  - a) The X in 78 will enter the X-Pickup hubs of the selector causing the selector to *transfer*. At this time there will be an internal connection between the Common hubs of the selector and the Controlled (Transferred) hubs. No impulses wired into Common can possibly come out of the Normal hubs when the selector is Controlled. Since we do not want to print on X 78 cards at all, the Controlled hubs are not wired to any typebars.
  - b) The selector "drops out" after the X78 card has passed through.

Exercises: Diagram the following exercises on the blank control panel diagrams provided in the back part of this lesson. Compare your solution with the school solution which will also be found in the back part of the lesson.

1. We are given a deck of cards and told to interpret them according to the following instructions:
  - a) c.c. 1-4 in all cards to be printed in t.b. 7-10.
  - b) c.c. 17-20 to be interpreted in t.b. 13-16 for NX 60 cards only.

2. We are given a deck of cards and told to interpret them according to the following instructions.

- a) c.c. 37-45 in all cards to be printed in t.b. 1-9.
- b) c.c. 3-8 to be interpreted in t.b. 34-39 for X 79 cards only.

## 6.2 Types of Selection:

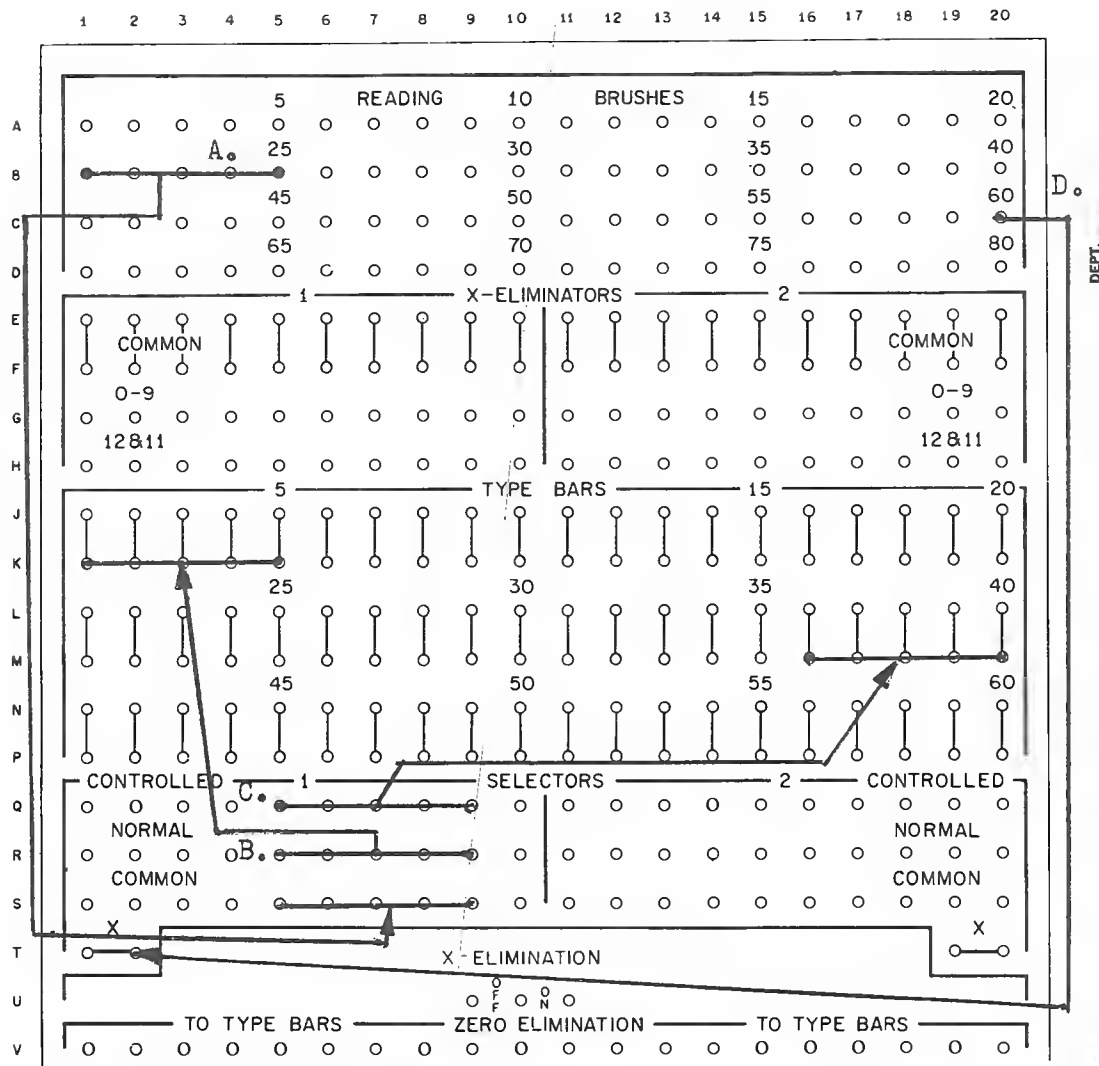
There are two general types of selection problems:

1. Class Selection: This general type of problem requires the same field to be interpreted in different typebars for different types of cards or not to be interpreted at all for some types of cards.
2. Field selection: this general type of problem requires different fields in a deck of cards to be interpreted and printed in the same typebars. In other words, for one type of card we will interpret c.c. 1-4 in t.b. 5-8; in another type of card we will interpret c.c. 21-24 in t.b. 5-8.

Let us analyze and study several problems in both field and class selection.

Problem 1: A company provides both gas and electric service.

Cards for both types of services are in a single deck. The amount to be billed the customer is punched in c.c. 21-25. The amount to be billed for electric customers is to be interpreted in t.b. 1-5; the amount to be billed for gas customers is to be interpreted in t.b. 36-40. We are also told that gas cards have an identifying X control punch in column 60.



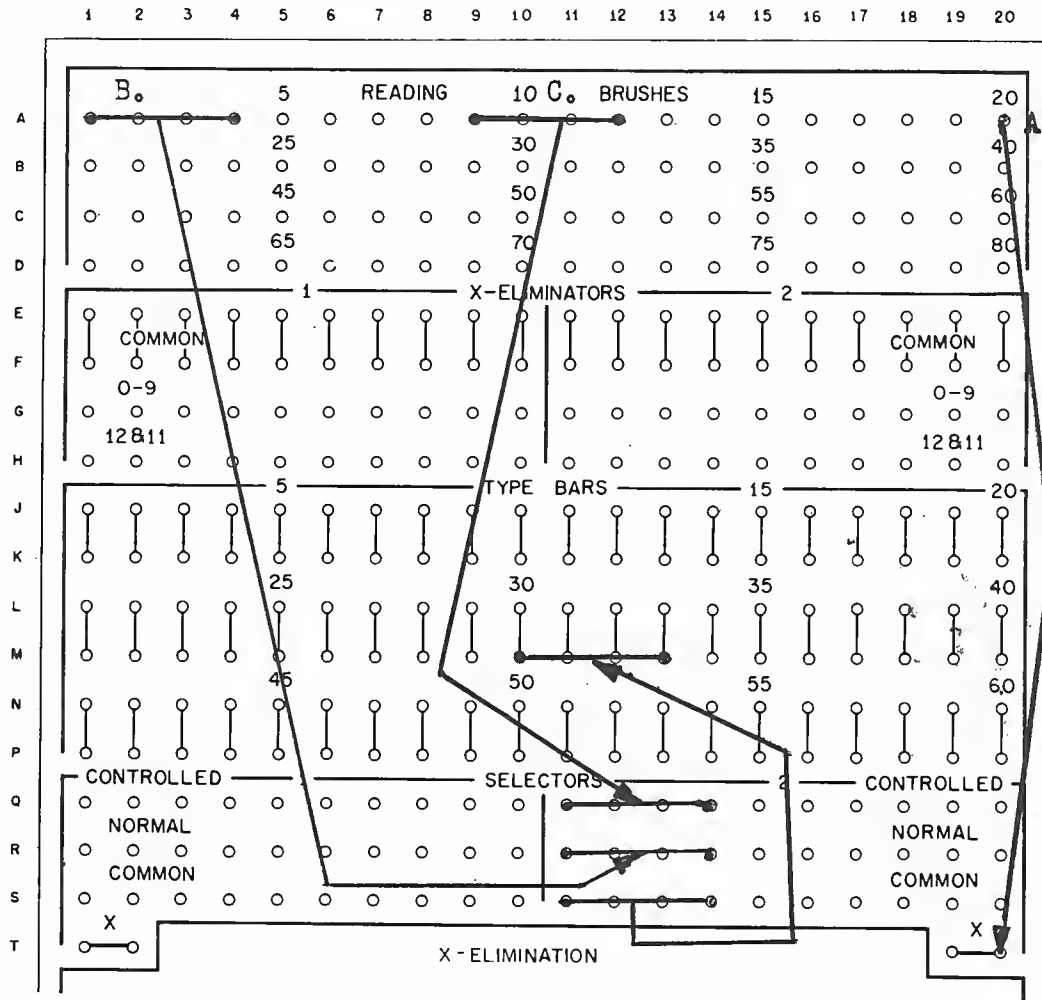
*Problem 1 — solution*

Notes:

- A) c.c. 21-25 are wired to the Common hubs of selector 1.
- B) The selector will be Normal for electric cards and the amount field which has entered the Common hubs will come out of the Normal hubs to print in t.b. 1-5.
- C) The selector will be transferred for gas cards and the amount field which has entered the Common hubs will come out of the Controlled hubs to print in t.b. 36-40.
- D) The X in column 60 will cause the selector to be picked up (transferred) for all gas cards.

Problem 2: A company has both factory and office employees. Cards for both types of employees are in the same deck. The office employee cards have employee number punched in c.c. 1-4; the factory employee cards have employee num-

ber punched in c.c. 9-12. In all cases however, the employee number is to be interpreted in t.b. 30-33. We are also told that factory employee cards have an X control punch in c.c. 20.



*Problem 2 — solution*

Notes:

- A) The X control punch for factory employees will energize the selector magnet for X20 cards and will transfer the selector.
- B) c.c. 1-4 will enter the Normal hubs of the selector when office employee cards are being read. At this time, the selector will be Normal and the data entering the Normal hubs will come out of the Common hubs to reach t.b. 30-33.
- C) c.c. 9-12 will enter the Controlled hubs of the selector when factory employee cards are being read. Since the selector will be

Transferred for factory employee cards (they have an X20) the data entering the Controlled hubs will come out of the Common hubs and reach t.b. 30-33.

\*At this point you will notice that selector hubs can be either Entry or Exit hubs depending on the problem. In the class selection problem which preceded this one, the Common hubs were Entry hubs and the Normal and Controlled hubs were Exit hubs. In this problem, the Normal and Controlled hubs are Entry hubs and the Common hubs are Exit hubs.

Problem 3: We are given a deck of cards some of which contain X10 and others do not. We are to wire an interpreter panel to accomplish the following:

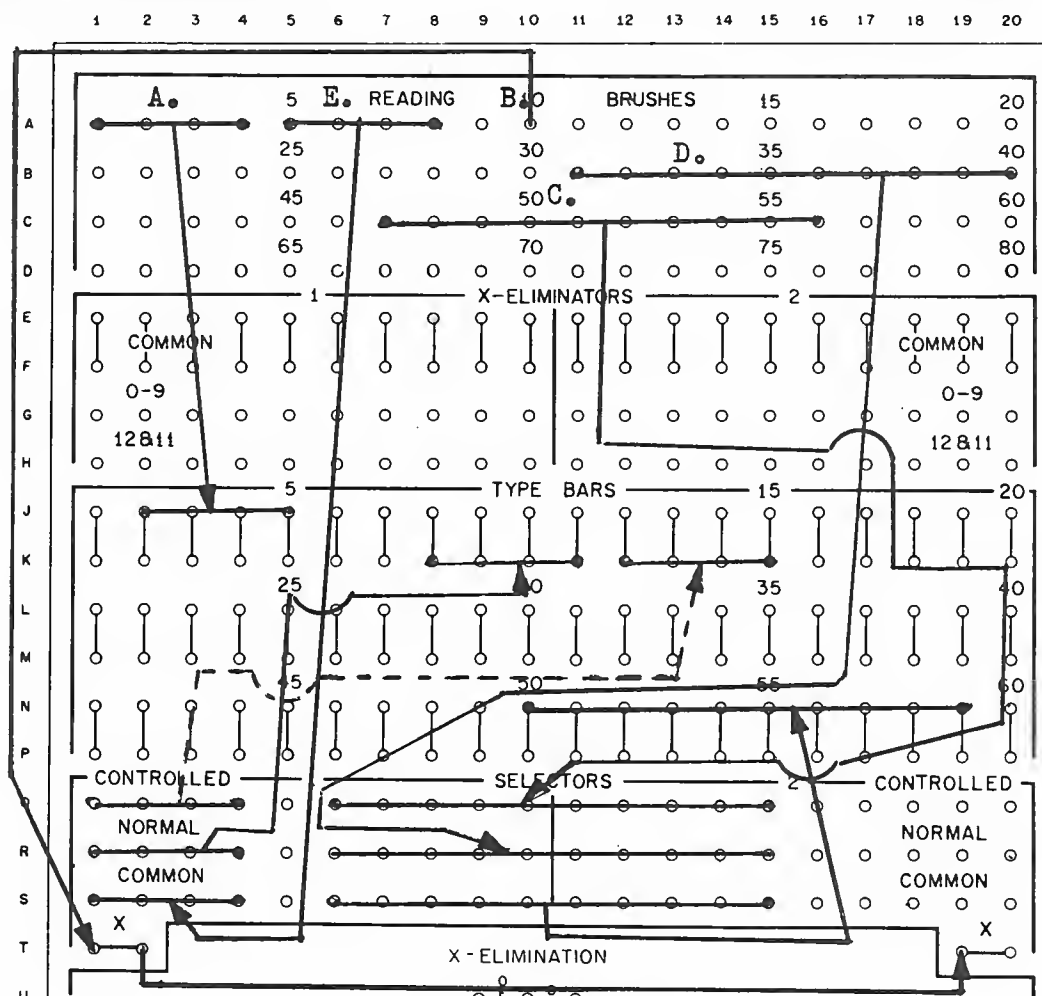
a. Print c.c. 1-4 in all cards in t.b. 2-5

b. Print c.c. 5-8 in NX10 cards in t.b. 8-11

Print c.c. 5-8 in X 10 cards in t.b. 12-15

c. Print c.c. 31-40 from NX10 cards in t.b. 50-59

Print c.c. 47-56 from X10 cards in t.b. 50-59



Problem 3 — solution

Notes: Study this problem and its solution carefully as it contains a review of all the selector principles discussed to date in this lesson.

A) c.c. 1-4 wired directly to t.b. 2-5 and will print for every card.

B) c.c. 10 is wired to the X-Pickup hub of selector 1 and from the common X-Pickup hub of selector 1 to the X-Pickup hub of selector 2. The result of this wiring is that *both* selectors will transfer when an X10 card is read. Remember our definition of hubs which are connected on the diagram by a line as the X-Pickup hubs are. These are called Common hubs, and an impulse wired into one of them is available from the other. There is a distinction between "Common hubs" and "the Common hubs of a selector."

C) c.c. 47-56 are wired to the Controlled hubs of selectors 1 & 2. These selectors will both be transferred for X10 cards and the data entering the Controlled hubs will come out of the Common hubs to print in t.b. 50-59.

D) c.c. 31-40 are wired to the Normal hubs of selector 1 & 2. These selectors will be Normal for NX 10 cards and the data entering the Normal hubs will come out of the Common hubs to print in t.b. 50-59.

E) c.c. 5-8 will enter the Common hubs of selector 1 for all cards. For NX 10 cards when the selector is Normal, the data from 5-8 will come out of the Normal hubs and print in t.b. 8-11; for X10 cards when the selector is transferred, the data from 5-8 will come out of the Controlled hubs and print in t.b. 12-15.

Exercises: Diagram the following exercises on the blank control panel diagrams provided in the back part of this lesson. Compare your solution with the school solution which will also be found in the back part of the lesson.

3. We are given a deck of cards to interpret along with the following instructions:

- a. Print c.c. 23-28 in t.b. 1-6 Eliminate X in c.c. 28.
- b. Print c.c. 41-43 in t.b. 9-11 for NX 60 cards.
- c. Print c.c. 41-43 in t.b. 57-59 for X 60 cards.

4. We are given a deck of cards to interpret along with the following instructions:

- a. Print c.c. 8-12 in t.b. 1-5 for X65 cards only.
- b. Print c.c. 32-39 in t.b. 13-20 for all

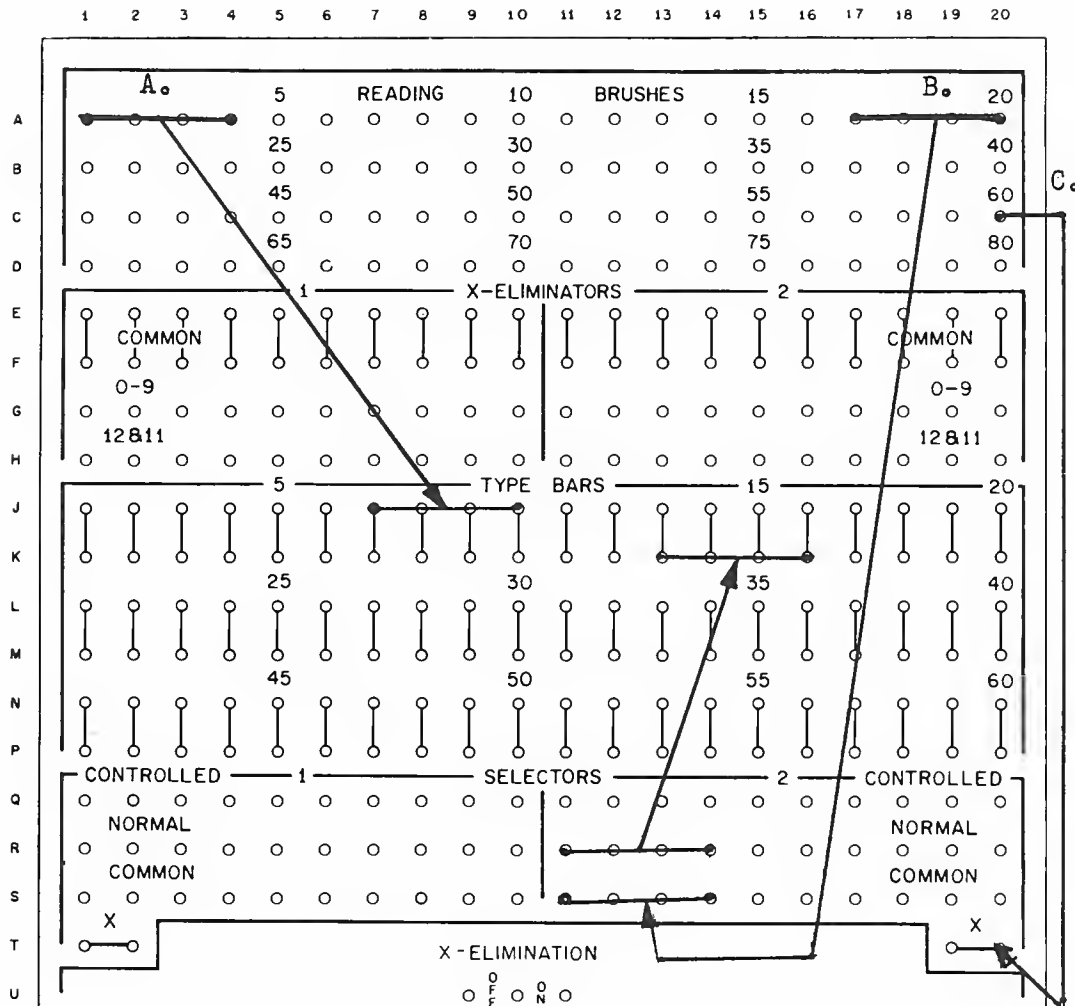
cards.

- c. Print c.c. 41-45 in t.b. 31-35 for NX65 cards.
- d. Print c.c. 50-54 in t.b. 31-35 for X65 cards.

5. We are given a deck of cards to interpret along with the following instructions:

- a. Print c.c. 75-80 in t.b. 15-20 for all cards.
- b. Print c.c. 12-15 in t.b. 1-4 for X 39 cards only.
- c. Print c.c. 55-59 in t.b. 9-13 for NX39 cards only.
- d. Print c.c. 21-24 in t.b. 57-60 for NX 60 cards.
- e. Print c.c. 21-24 in t.b. 37-40 for X60 cards.



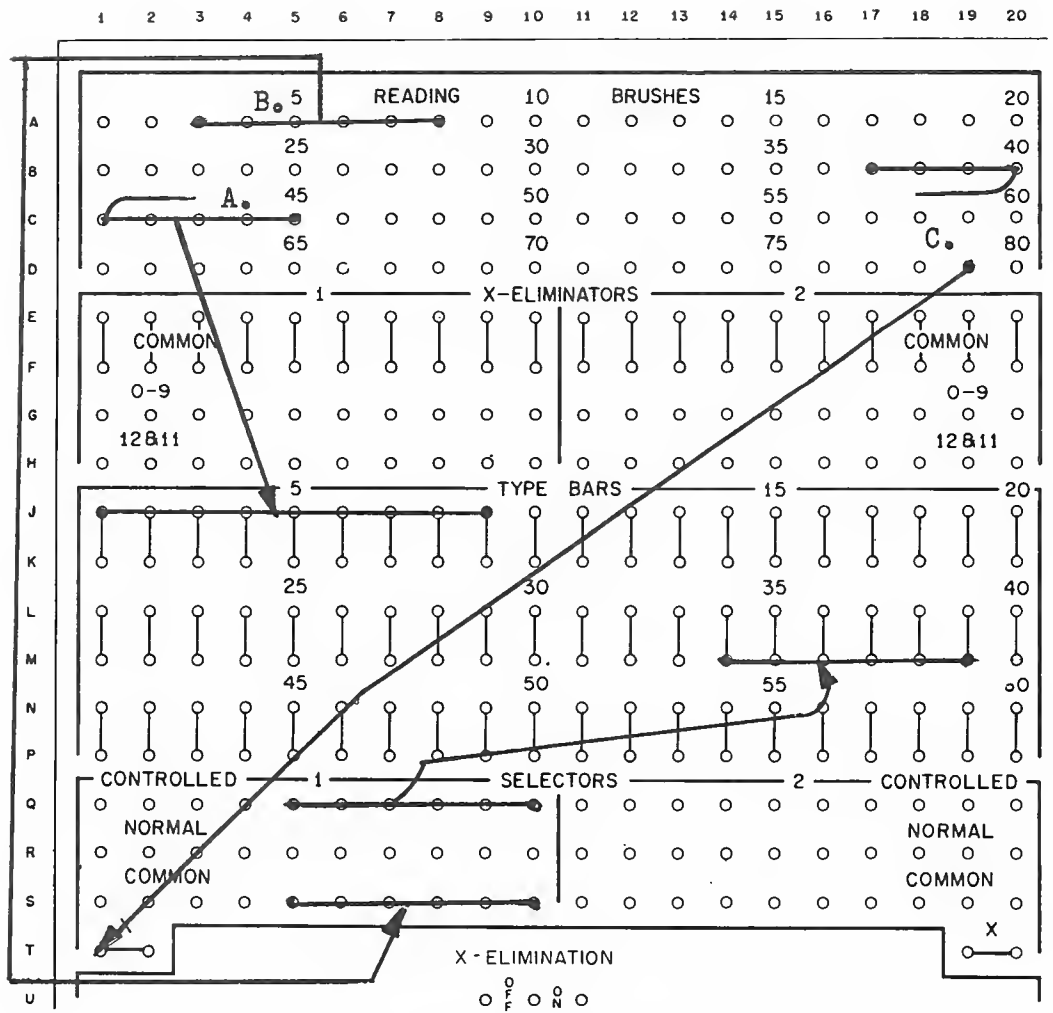


*Exercise 1 — solution*

Notes:

- A) c.c. 1-4 wired directly to t.b. 7-10 and will print for all cards.
- B) c.c. 17-20 wired to the Common hubs of selector 2, and from the Normal hubs to t.b. 13-16. Note that either selector 1 or 2 could have been used.
- C) c.c. 60 is wired to the X-Pickup hub of selector 2. Should a card contain an X

in c.c. 60, this X impulse would cause the magnets for selector 2 to be energized and Transfer the selector. In a transferred condition, there is an internal connection between the Common and Transferred hubs of the selector and the information entering the Common hubs *would not* reach the typebars.

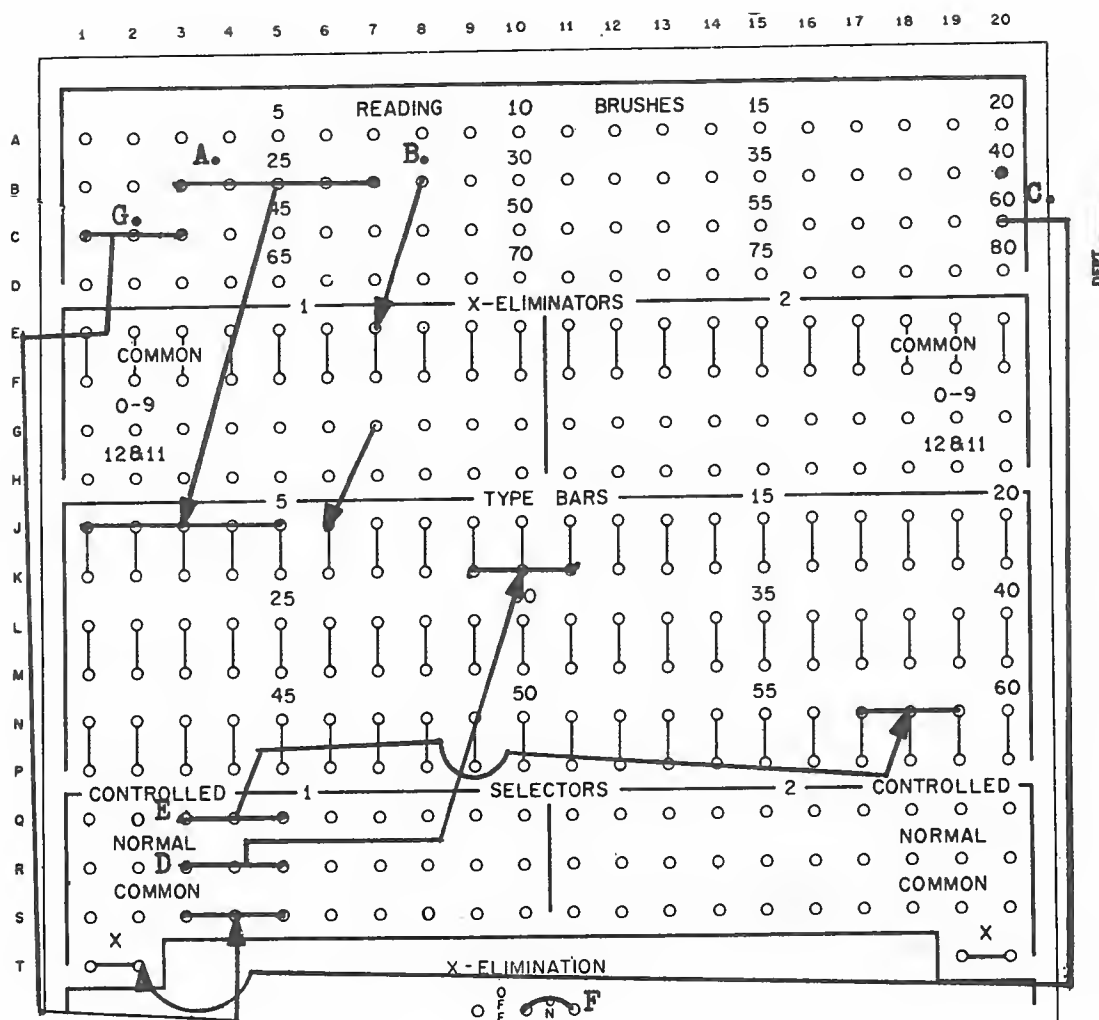


Exercise 2 — solution

Notes:

- A) c.c. 37-45 wired directly to t.b. 1-9 and will print for each card.
- B) c.c. 3-8 wired to the Common hubs of selector 1, and from the Transferred hubs to t.b. 34-39. Note that either selector 1 or 2 could have been used.
- C) c.c. 79 is wired to the X-Pickup hub of selector 1. There is an internal connection

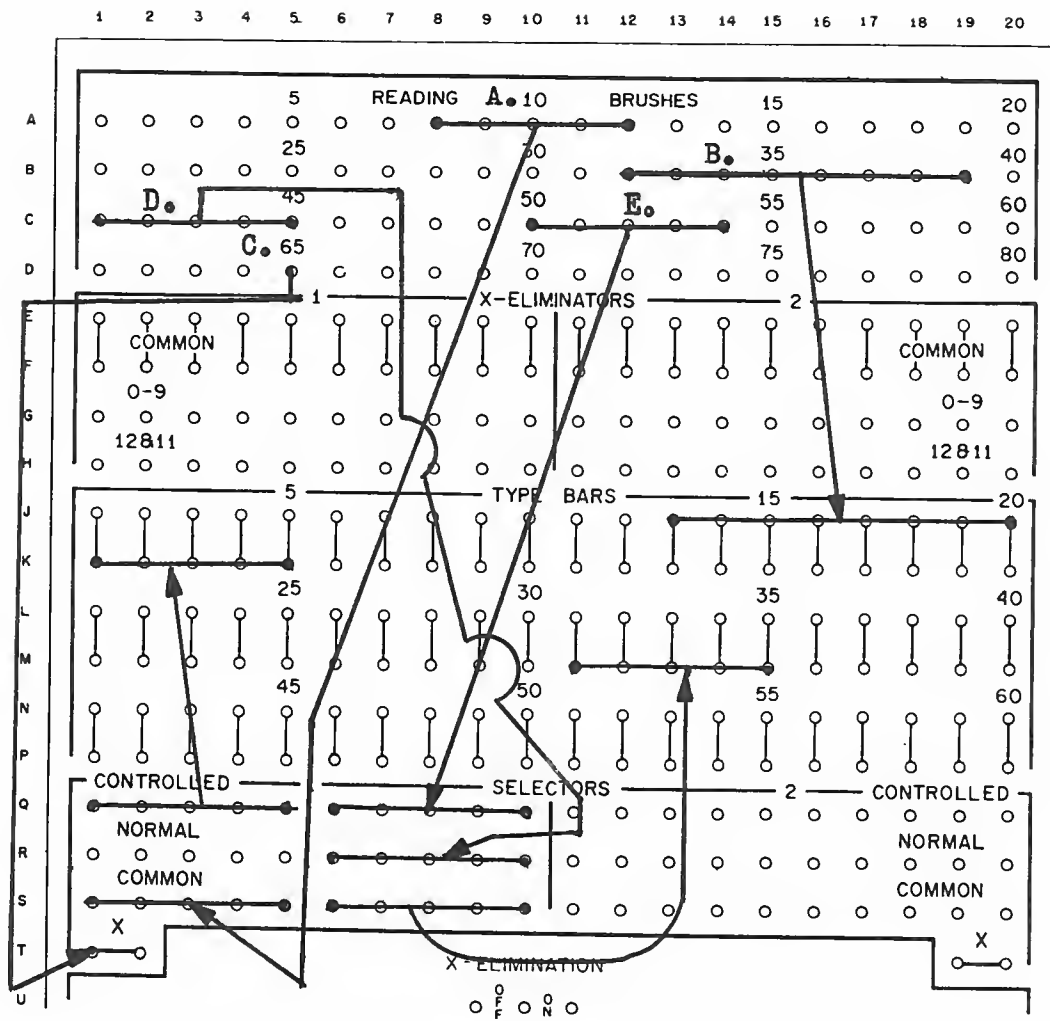
between the Common and Transferred hubs of a selector only when the selector magnets are energized. In this case they would be energized for every card with an X79. For all NX79 cards, the selector would be Normal and the information entering the Common hubs would not come out of the Transferred hubs. Therefore, we would not print in t.b. 34-39 for any NX 79 cards.



Exercise 3 — solution

Notes:

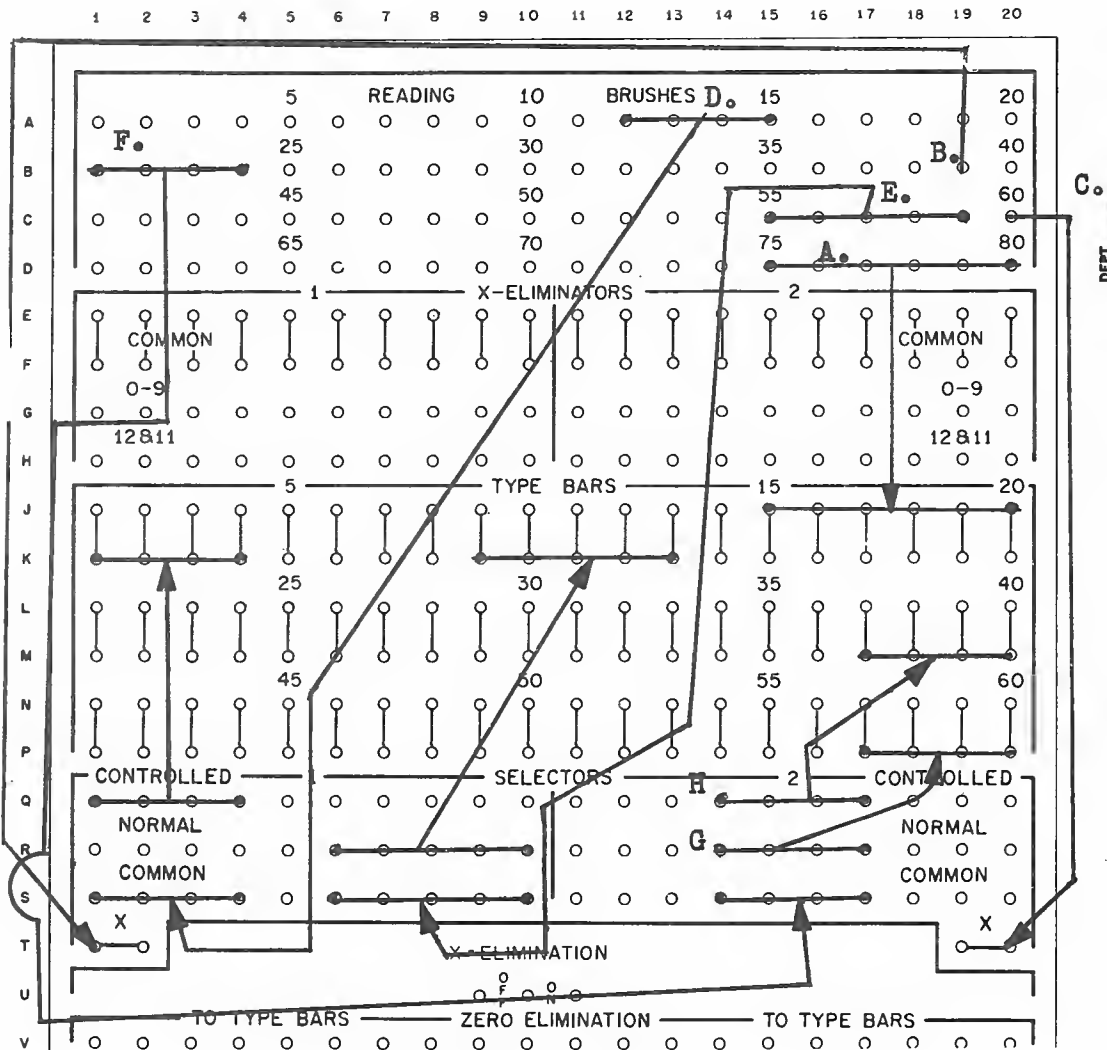
- A) c.c. 23-27 wired directly to t.b. 1-5.
- B) c.c. 28 wired to the Common hub of an X-Eliminator and from the 0-9 hub to t.b. 6. This eliminates the X from c.c. 28 from reaching the typebar.
- C) c.c. 60 wired to the X-Pickup hub of selector 1. An X read in this column will cause the selector to transfer.
- D) When the selector is Normal (for NX 60 cards) an internal connection is established between the Normal and Common hubs so that c.c. 41-43 which enters the Common hubs will be available from the Normal hubs and reach t.b. 9-11.
- E) When the selector is Controlled (for X60 cards an internal connection is established between the Common and Controlled hubs so that c.c. 41-43 which enters the Common hubs will be available from the Controlled hubs and reach t.b. 57-59.
- F) The X-Eliminator switch is wired ON
- G) c.c. 41-43 wired to the Common hubs of selector 1.



*Exercise 4 — solution*

Notes:

- A) c.c. 8-12 wired to the Common hubs of selector 1. Since there is an internal connection between Common and Controlled when the selector is transferred, the data entering the Common hubs will print in t.b. 1-5 for X65 cards only.
- B) c.c. 32-39 wired directly to t.b. 13-20 to print for all cards.
- C) c.c. 65 wired to the X-Pickup hub of selector 1. This selector will transfer for all X65 cards.
- D) c.c. 41-45 enter the Normal hubs of selector 1 and will be available from the Common hubs when the selector is Normal (or for all NX65 cards.) When the selector is Normal c.c. 41-45 will print in t.b. 31-35.
- E) c.c. 50-54 enter the Controlled hubs of selector 1 and will be available from the Common hubs when the selector is transferred (or for all X65 cards.) Therefore, when the selector is Transferred, c.c. 50-54 will print in t.b. 31-35.



Exercise 5 — solution

Notes:

- A) c.c. 75-80 wired directly to t.b. 15-20 to print for all cards.
- B) c.c. 39 wired to the X-Pickup hub of selector 1. This selector will transfer for all X39 cards.
- C) c.c. 60 wired to the X-Pickup hub of selector 2. This selector will transfer for all X60 cards.
- D) c.c. 12-15 wired to the Common hubs of selector 1. If the card passing through the machine has an X39, this selector will transfer, an internal connection will be established between the Common and Controlled hubs and the information in c.c. 12-15 will print in t.b. 1-4.
- E) c.c. 55-59 wired to the Common hubs of selector 1. This information will be available from the Normal hubs for all NX39 cards and will print in t.b. 9-13.

- F) c.c. 21-24 enters the Common hubs of selector 2.
- G) For all NX60 cards, an internal connection is established between the Common and Normal hubs of selector 2 and c.c. 21-24 will print in t.b. 57-60.
- H) For all X60 cards, the internal connection will be between the Common and Controlled hubs of selector 2 and c.c. 21-24 will print in t.b. 37-40.

An understanding of the basic principles involved in selection and X-Elimination will be invaluable as an aid to understanding the machines to be discussed in subsequent lessons on punched card equipment and in some areas in computer programming. Reread and review this lesson and lesson 5 until you fully understand the lesson material. Consult your glossary for a clarification of those terms which you are not sure of.

## GLOSSARY

*Class Selection* — Printing one field in one of two places. For those cards with a control punch the field will print in one place; those cards without a control punch will print in another place.

*Common Hub* (of a selector) — labelled "C". This hub is always connected with another hub in the selector group. If the selector is Normal, the Common hub is connected with the Normal hub; if the selector is Transferred the Common hub is connected with the Controlled hub.

*Controlled Hub* (of a selector) — this is the hub of a selector which is internally connected with the Common hub when the selector is in a Transferred condition.

*Field Selection* — Printing one or more fields in the same typebars depending on a control punch.

*Normal* — A term which describes the condition of a selector which has not been picked-up. In this condition, there is an internal connection between the Common and Normal hubs of the selector.

*Normal Hub* (of a selector) — this is the hub of a selector which is internally connected with the Common hub when the selector is *not* transferred.

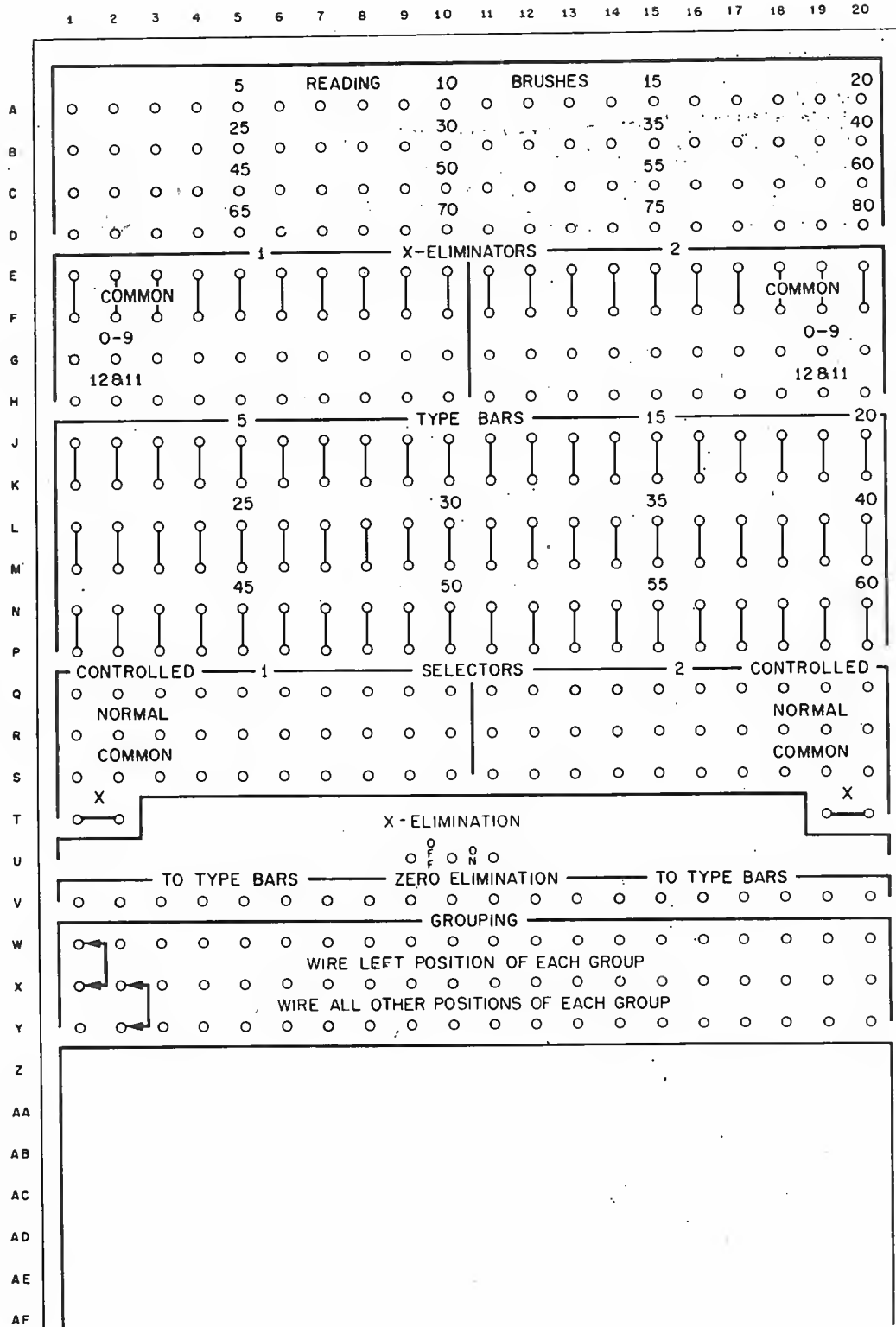
*Picked-Up* — a term which indicates that the selectors X-Pickup hubs have received an X impulse and that the selector is Transferred.

*Selector* — a machine device which permits the machine to make decisions based upon proper control panel wiring. The selector will consist of a Pick-up hub and three other types of hubs, Common, Normal and Controlled (or Transferred) Selectors can be in one of two conditions at any one time: Normal—at which time there is an internal connection between the Common and Normal hubs; Controlled—at which time there is an internal connection between the Common and Controlled hubs. Note that there can never be an internal connection between the Normal and Controlled hubs. Selectors never transfer automatically as X-Eliminators do. They must be picked-up (the magnet must be impulsed) by control panel wiring.

*Transferred* — A term which describes the condition of a selector after its X-Pickup hub has received an impulse. In this condition, there is an internal connection between the Common and Transferred hubs of the selector.

*X-Pickup Hubs* (of a selector) — these are hubs which will only accept and recognize an "X" impulse. When they receive an impulse they cause the selector to transfer immediately and stay transferred for the balance of the "X" card after which the selector returns to its normal condition.

## IBM 552 CONTROL PANEL

[illegible]

ON

360

## PRINTING POSITIONS

[illegible]

## IBM 552 CONTROL PANEL

ELECTRO NO.	CARD NAME OR FUNCTION	/	X OR D CODE	NOTES:
		-		

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
A	○	○	○	○	5		READING		10		BRUSHES		15							20	
B	○	○	○	○	25				30				35							40	
C	○	○	○	○	45				50				55							60	
D	○	○	○	○	65				70				75							80	
E					X-ELIMINATORS																
F	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
G	COMMON				○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
H	0-9				○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
I	12811				○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
J					TYPE BARS																
K	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
L	○	○	○	○	25				30				35							40	
M	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
N	○	○	○	○	45				50				55							60	
O	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
P	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
Q	CONTROLLED				SELECTORS										CONTROLLED						
R	NORMAL				○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
S	COMMON				○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
T	X				X-ELIMINATION										X						
U					ZERO ELIMINATION																
V	TO TYPE BARS				TO TYPE BARS										TO TYPE BARS						
W					GROUPING																
X					WIRE LEFT POSITION OF EACH GROUP																
Y					WIRE ALL OTHER POSITIONS OF EACH GROUP																
Z																					
AA																					
AB																					
AC																					
AD																					
AE																					
AF																					

NAME \_\_\_\_\_

USE

## PRINTING POSITIONS

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## IBM 552 CONTROL PANEL

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	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
A	O	O	O	O	5		READING		10		BRUSHES		15							20				
B	O	O	O	O	25				30				35							40				
C	O	O	O	O	45				50				55							60				
D	O	O	O	O	65				70				75							80				
E					1	X-ELIMINATORS										2								
F	COMMON																COMMON							
G	0-9																0-9							
H	12&11																12&11							
I					5	TYPE BARS										15								
J					25				30				35							40				
K																								
L					45				50				55							60				
M																								
N																								
O																								
P	CONTROLLED				1	SELECTORS										2	CONTROLLED							
Q	NORMAL																NORMAL							
R	COMMON																COMMON							
S																								
T	X				X-ELIMINATION																X			
U					O F O N O																			
V	TO TYPE BARS				ZERO ELIMINATION																TO TYPE BARS			
W	GROUPING																							
X	WIRE LEFT POSITION OF EACH GROUP																							
Y	WIRE ALL OTHER POSITIONS OF EACH GROUP																							
Z																								
AA																								
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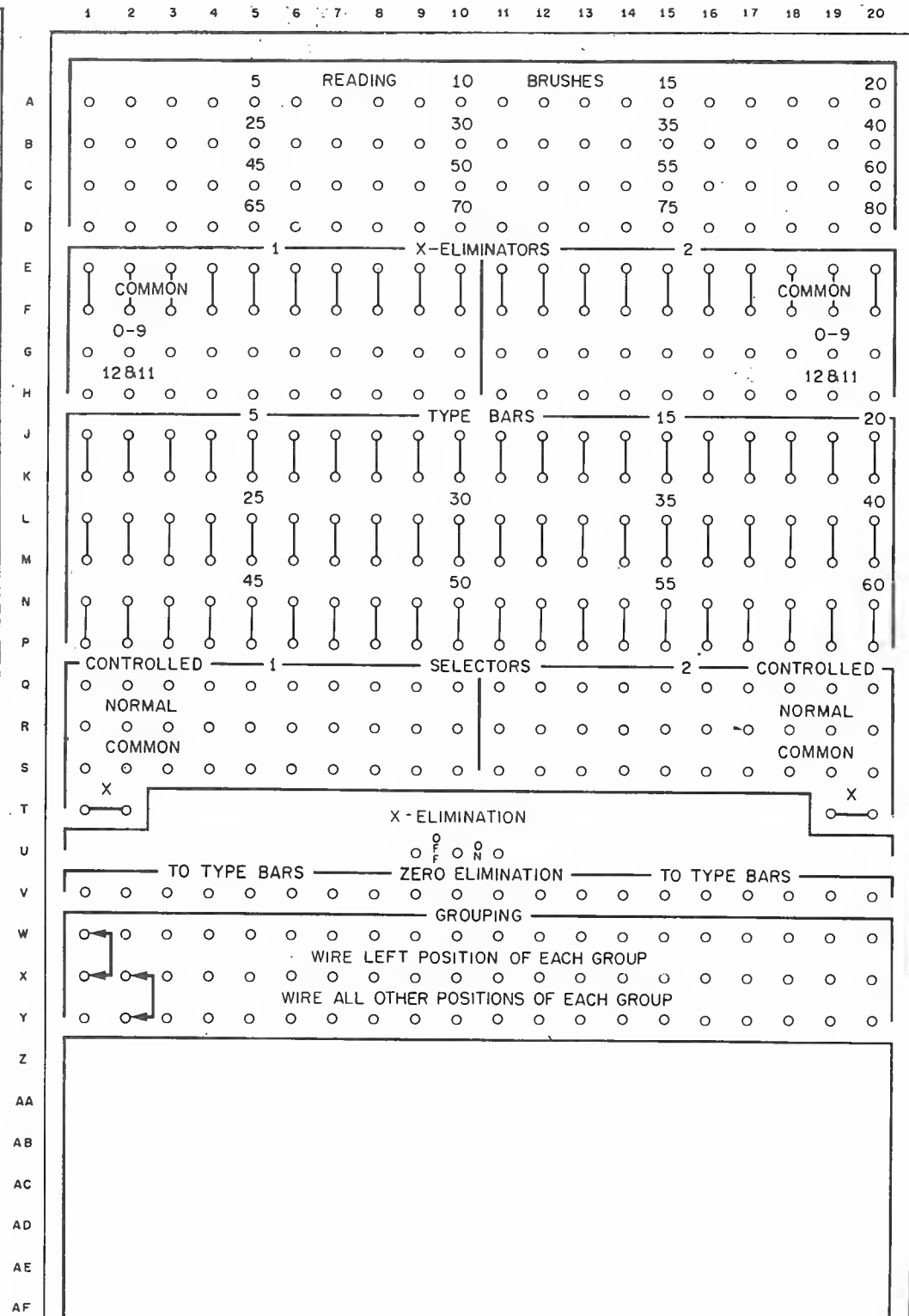
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	○	○	○	○	5		READING		10		BRUSHES		15							20
B	○	○	○	○	25				30				35							40
C	○	○	○	○	45				50				55							60
D	○	○	○	○	65				70				75							80
E					X-ELIMINATORS															
F	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
G	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
H	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
J					TYPE BARS															
K	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
L	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
M	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
N	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
P	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Q					SELECTORS															
R	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
S	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
T					X-ELIMINATION															
U					TO TYPE BARS															
V	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
W					GROUPING															
X					WIRE LEFT POSITION OF EACH GROUP															
Y					WIRE ALL OTHER POSITIONS OF EACH GROUP															
Z																				
AA																				
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NAME \_\_\_\_\_

USE

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## IBM 552 CONTROL PANEL

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**USE**

## PRINTING POSITIONS

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The diagram illustrates the wiring for the Electronic Computer Programming Institute. It features a grid of 20 columns and 26 rows, labeled A through Z. The columns are numbered 1 to 20 at the top. The rows are labeled A through Z on the left. The diagram includes several sections with specific labels and connections:

- READING (Columns 5-10):** Labeled "READING" at the top. It includes a "COMMON" label and "0-9" and "12&11" labels. Connections are shown for rows A through D.
- BRUSHES (Columns 11-16):** Labeled "BRUSHES" at the top. It includes a "COMMON" label and "0-9" and "12&11" labels. Connections are shown for rows A through D.
- X-ELIMINATORS (Columns 17-20):** Labeled "X-ELIMINATORS" at the top. It includes a "COMMON" label and "0-9" and "12&11" labels. Connections are shown for rows A through D.
- TYPE BARS (Columns 1-20):** Labeled "TYPE BARS" at the top. It includes a "COMMON" label and "0-9" and "12&11" labels. Connections are shown for rows A through D.
- SELECTORS (Columns 1-20):** Labeled "SELECTORS" at the top. It includes a "COMMON" label and "0-9" and "12&11" labels. Connections are shown for rows A through D.
- CONTROLLED (Columns 1-20):** Labeled "CONTROLLED" at the top. It includes a "COMMON" label and "0-9" and "12&11" labels. Connections are shown for rows A through D.
- X-ELIMINATION (Columns 1-20):** Labeled "X-ELIMINATION" at the top. It includes a "COMMON" label and "0-9" and "12&11" labels. Connections are shown for rows A through D.
- TO TYPE BARS (Columns 1-20):** Labeled "TO TYPE BARS" at the top. It includes a "COMMON" label and "0-9" and "12&11" labels. Connections are shown for rows A through D.
- GROUPING (Columns 1-20):** Labeled "GROUPING" at the top. It includes a "COMMON" label and "0-9" and "12&11" labels. Connections are shown for rows A through D.
- WIRE LEFT POSITION OF EACH GROUP (Columns 1-20):** Labeled "WIRE LEFT POSITION OF EACH GROUP" at the top. It includes a "COMMON" label and "0-9" and "12&11" labels. Connections are shown for rows A through D.
- WIRE ALL OTHER POSITIONS OF EACH GROUP (Columns 1-20):** Labeled "WIRE ALL OTHER POSITIONS OF EACH GROUP" at the top. It includes a "COMMON" label and "0-9" and "12&11" labels. Connections are shown for rows A through D.

The diagram is a detailed wiring schematic for the Electronic Computer Programming Institute, showing the connections between various components and the grid of columns and rows.

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## EXAMINATION

INSTRUCTIONS: Your examinations are important to you as they indicate how well you understand the lesson material. Be sure to allow yourself enough time to complete the examination. Read each question carefully and be sure you understand it. Mark your answers in the proper box. Review the exam to be sure that all questions have been answered.

Answer the following questions True or False. If True, mark an X in box A; if False, mark an X in Box B.

1. When a selector is Normal, there is an internal connection between the Normal and Controlled hubs.
  2. When a selector is transferred there is an internal connection between the Common and Normal hubs.
  3. Selectors transfer automatically as the "12" and "11" zones are being read from each card.
  4. The X-Pickup hubs of a selector will accept and recognize any digit impulse.
  5. It is possible for Selector one to be in a Transferred condition and for Selector two to be in a Normal condition for the same card.
  6. To pick-up both selectors at the same time, wire from reading brush to the X-Pickup hub of one selector, then from the common X-pickup hub of that same selector to the X-pick-up hub of the other selector.
  7. Selector hubs can be either exit or entry hubs.
  8. Class selection means printing one field in one of two places.
  9. Selectors drop out automatically at the end of each cycle.
  10. When a selector is Transferred, there is an internal connection between the Common and Controlled hubs.
- Refer to the diagram marked Figure 7 and answer the following questions True or False.
11. The X-Eliminator switch should be wired ON for this problem.
  12. Selector 1 will transfer for all X29 cards.
  13. c.c. 44-46 will print in t.b. 26-28 for X29 cards.
  14. c.c. 5-8 will print in t.b. 7-10 for all cards.
  15. c.c. 55-58 will print in t.b. 57-60 for X80 cards only.
  16. c.c. 41-43 will print in t.b. 26-28 for X29 cards.
  17. c.c. 70-72 will print in t.b. 36-38 for X80 cards.
  18. c.c. 44-46 will print in t.b. 26-28 for NX29 cards.
  19. c.c. 70-72 will print in t.b. 32-34 for X80 cards.
  20. Assume that a card has both an X29 and an X80. When this card is being interpreted both selectors will be transferred.

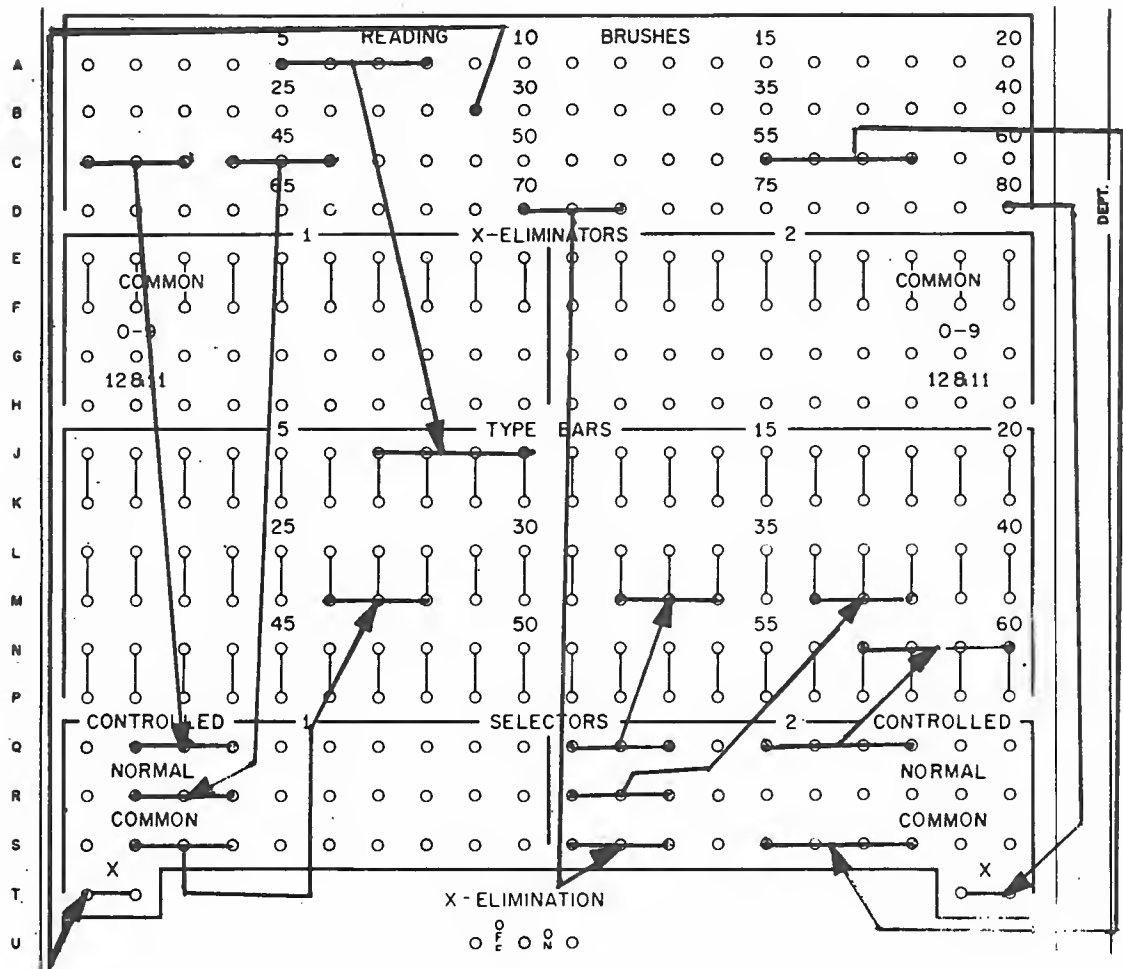


Figure 7.

# **I.B.M. DATA PROCESSING AND COMPUTER PROGRAMMING**

## **LESSON No. 7**

### **TABLE OF CONTENTS**

- 7.1) The IBM type 082 Sorter
- 7.2) Operating Principles
- 7.3) Card Handling and Checking
- 7.4) Numerical Sorting
- 7.5) Selective Sorting
- 7.6) Alphabetical Sorting

Glossary

Examination

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**ELECTRONIC COMPUTER PROGRAMMING INSTITUTE**

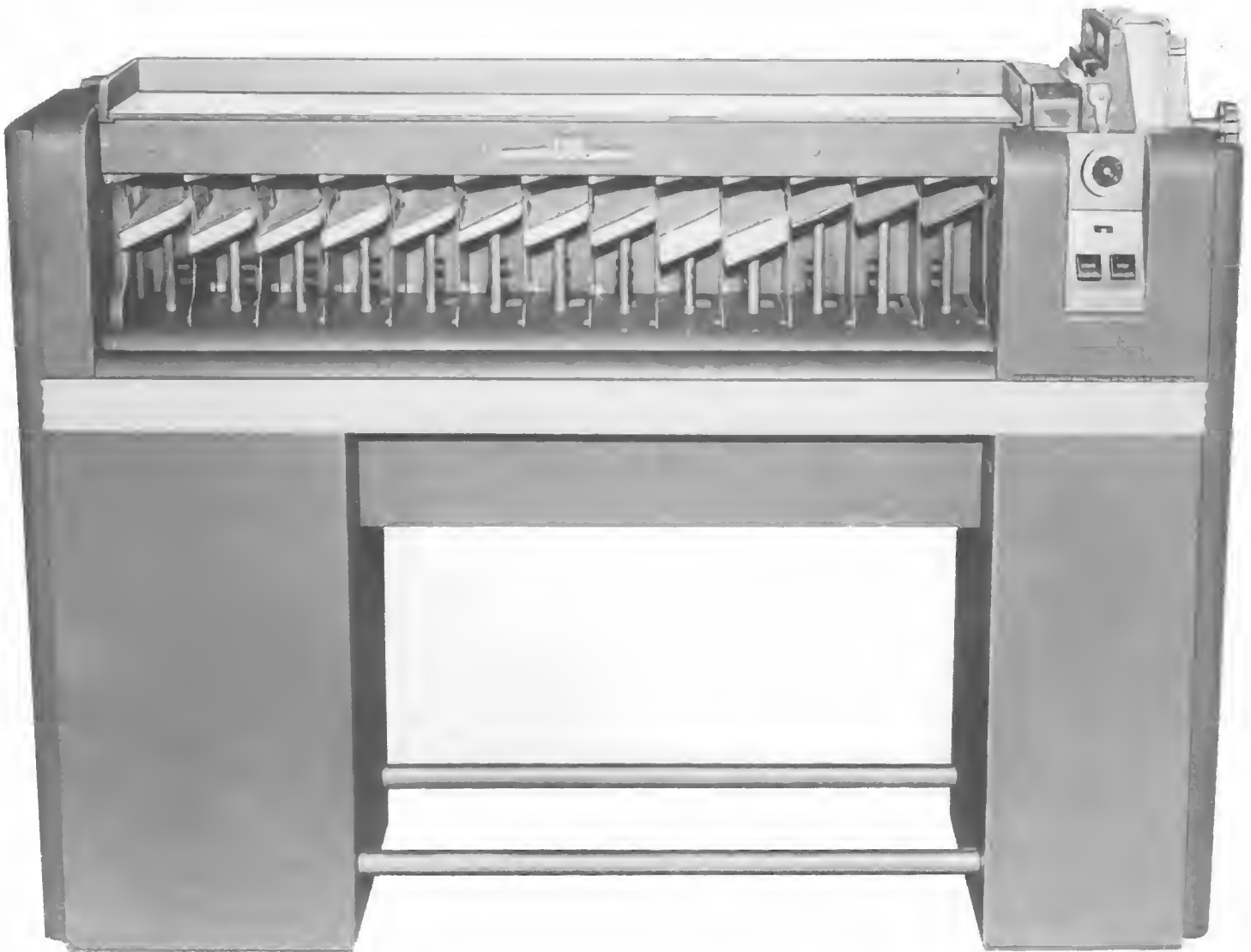




## PREFACE

Up to this point, we have studied how IBM cards are read visually, how they are created on the IBM key punch and how they are interpreted (read by machines, the IBM Interpreter.) We have also studied various general principles which are used in IBM Control Panel Wiring. These principles will again be discussed and used in the lessons that follow.

In the next few lessons, we are going to learn how IBM cards are placed in sequence (by using the IBM Sorter) and how automatic punching and automatic creation of IBM cards is accomplished (using the IBM Reproducing Punch).





## 7.1 The IBM 082 Sorter

In previous lessons, the IBM card was discussed in detail. Cards are punched on the 024 key punch and through their normal travels throughout the Data Processing installation are then placed in the 552 Interpreter and printed for easy reference.

Let us assume that we have punched 5000 cards such as the one illustrated in Figure 1 and now in

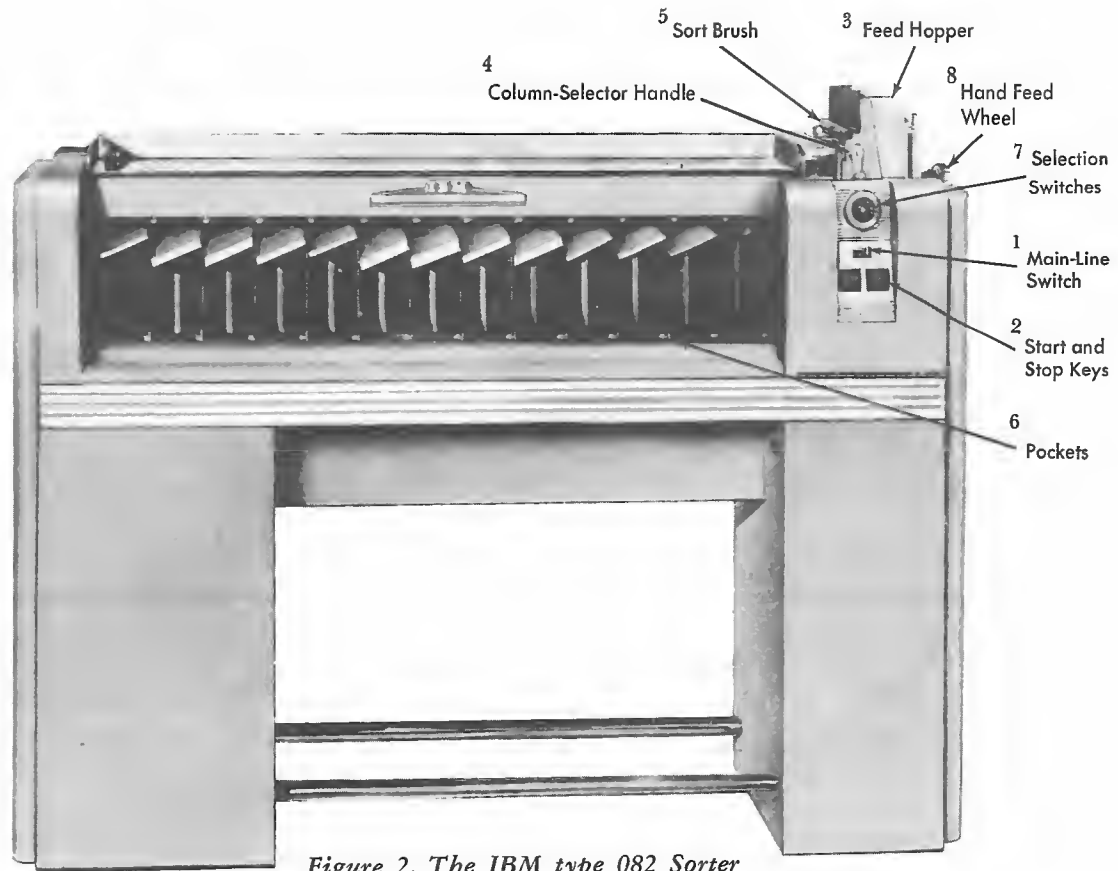
order to process these cards, we have to place them in sequence by employee number. Imagine trying to arrange a large group of cards like this in sequence manually, without the use of a machine. It may take hours or even days to manually arrange 5000 cards in a desired numerical or alphabetical sequence.

BOND AND EARNINGS SUMMARY CARD RECORD	EMPLOYEE NUMBER	EMPLOYEE NAME	SOCIAL SECURITY NUMBER	WITHOLDING TAX TO DATE	EARNINGS		O.A.B.	BOND				WEEK NO.	U.C.I.
					TO DATE	CURRENT		PRICE	OLD BALANCE	CURRENT CREDIT	NEW BALANCE		
0000	00000000000000000000	00000000000000000000	00000000000000000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1111	11111111111111111111	11111111111111111111	11111111111111111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111
2222	22222222222222222222	22222222222222222222	22222222222222222222	22222222	22222222	22222222	22222222	22222222	22222222	22222222	22222222	22222222	22222222
3333	33333333333333333333	33333333333333333333	33333333333333333333	33333333	33333333	33333333	33333333	33333333	33333333	33333333	33333333	33333333	33333333
4444	44444444444444444444	44444444444444444444	44444444444444444444	44444444	44444444	44444444	44444444	44444444	44444444	44444444	44444444	44444444	44444444
5555	55555555555555555555	55555555555555555555	55555555555555555555	55555555	55555555	55555555	55555555	55555555	55555555	55555555	55555555	55555555	55555555
6666	66666666666666666666	66666666666666666666	66666666666666666666	66666666	66666666	66666666	66666666	66666666	66666666	66666666	66666666	66666666	66666666
7777	77777777777777777777	77777777777777777777	77777777777777777777	77777777	77777777	77777777	77777777	77777777	77777777	77777777	77777777	77777777	77777777
8888	88888888888888888888	88888888888888888888	88888888888888888888	88888888	88888888	88888888	88888888	88888888	88888888	88888888	88888888	88888888	88888888
9999	99999999999999999999	99999999999999999999	99999999999999999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
JTC 41	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80												

Figure 1.

The function of the IBM 082 Sorter is to arrange cards in any desired numerical or alphabetical sequence. I might mention at this point that there are several types of IBM Sorters. The

basic difference between the various types is their operating speed. Figure 2 illustrates the IBM type 082 Sorter, the most common model in use today.

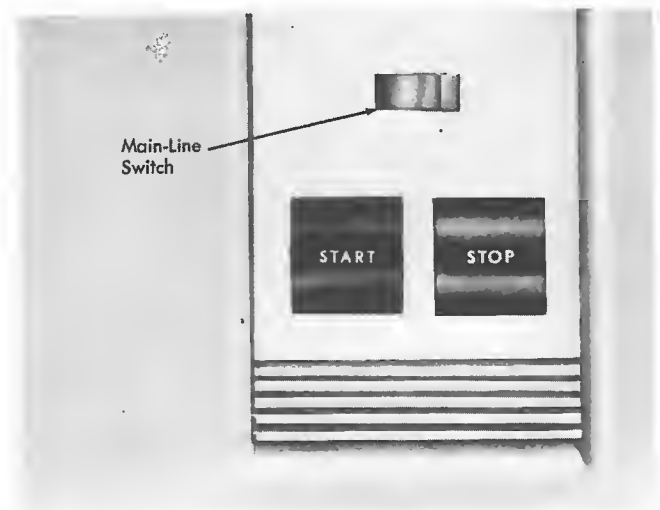


*Figure 2. The IBM type 082 Sorter*

Before discussing machine operation, let us look at the various machine features:

1. Main-Line Switch — When this switch is turned on, electrical power is supplied to the machine. Like the 024 key punch, the sorter also has tubes. It will take a few moments for the tubes to warm-up before the machine is ready for use.
2. Start and Stop Keys — Starting and stopping is accomplished instantaneously merely by pressing the proper key.
3. Feed Hopper — Those cards which are to be sorted are placed in the feed hopper. Cards are placed in the hopper "face down", "9 edge" first. The card at the bottom of the stack will feed first.

4. Column-Selector Handle — Before starting the machine, we must first decide which columns of the card are to be sorted. We then turn the column-selector handle which moves the column indicator to the desired column.



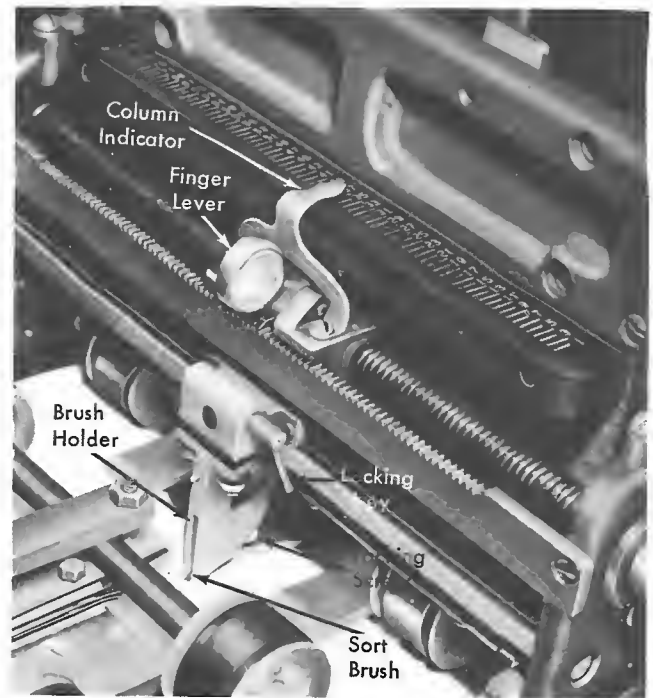
*Figure 3. Main-Line Switch — Start and Stop Keys*



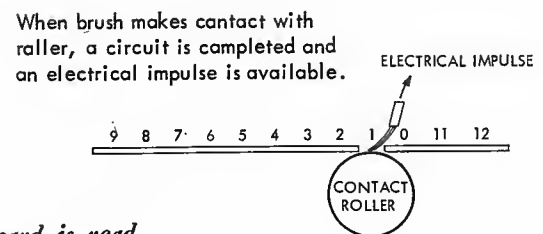
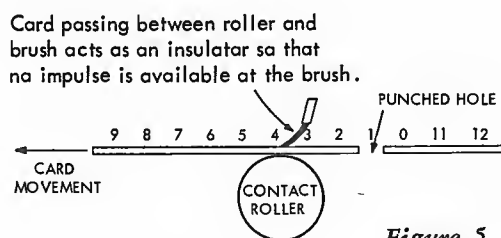
*Removing cards from the pockets after the sort*

5. Sort Brush — After the column-selector handle has been turned to the selected column, it will position the sorter brush so that it can read the punches in that column. Figure 4 illustrates the column-indicator and the sorter brush assembly. As the column-selector handle is turned, the column indicator will move to the desired column. Notice that the "shelf" on which the column indicator rests is calibrated from 1-80. These numbers correspond to our 80 card columns. When the column indicator rests on the desired card column, the sorter brush is positioned to read that column.

Figure 5 illustrates how the card is read. Card reading principles were studied in a prior lesson. For the purpose of review, let us mention that as the card passes between the brush and the contact roller it acts as an insulator so that no impulse is available at the brush. The brush will fall through the punched hole, make contact with the roller and an electrical impulse is available. This impulse is recognized as being a specific digit or letter by the "time" at which it is emitted.



*Figure 4. Column Indicator and Sort Brush*



*Figure 5. How a card is read.*

6. Pockets — There are 13 pockets in the sorter. There is a pocket for each of the 12 punching zones in the card, (12, 11, 0-9) and a pocket for rejects (those cards which are unpunched in a particular column).

As the cards are fed under the sorting brush, they will be directed into a pocket which corresponds to the punch in the card. See Figure 6.

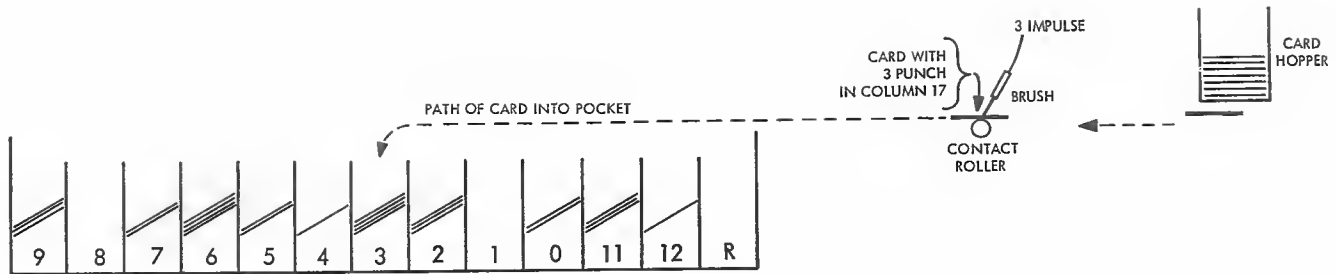


Figure 6. Path of card into a pocket.

7. Selection Switches — The 12 selection switches are mounted on a circular ring. They are used to select those cards which have a specific punch in a card column. The Alphabetic Sorting Switch is also contained on the selector switch ring. As the name implies, this switch is used in alphabetic sorting. The use of the selection switches and alphabetic sorting will be discussed in detail later on in this lesson.

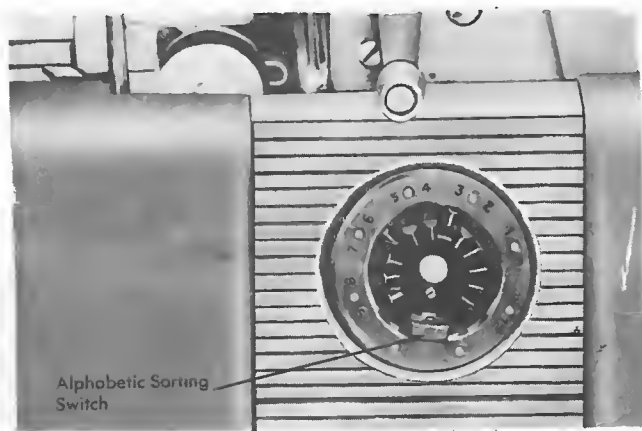


Figure 7. Selection Switches.

8. Hand Feed Wheel — This device has a very limited use. It is used to feed cards manually when there is a "jam" in the machine and the damaged cards are to be removed.

## 7.2 Operating Principles

Assume that the sorter has been turned on and

that it has warmed up and is ready to use. The first step in any sorting operation is to set the column indicator over the first column to be sorted. This is accomplished by turning the column-selector handle until the column indicator is in position. Since the "shelf" on which the column indicator rests is calibrated from 1-80 it is no problem knowing when the column indicator is in the proper position.

When sorting cards, you always sort the units position of your field first, then the tens position, then the hundreds position and so on. In our example, we are going to sort our cards into sequence by employee number. The employee number field is punched in c.c. 1-4. We will therefore sort our cards first on column 4, then column 3, then column 2, then column 1.

Note that we must pass our cards through the sorter as many times as we have columns in our field. After each pass, the column indicator is moved to the next column position.

As the cards pass through the machine they will pass under the sorting brush. The brush, reading the card, will direct the card into one of the 12 sorter pockets depending on the punch in the card. If the card is not punched (it is blank), it will enter the reject pocket.

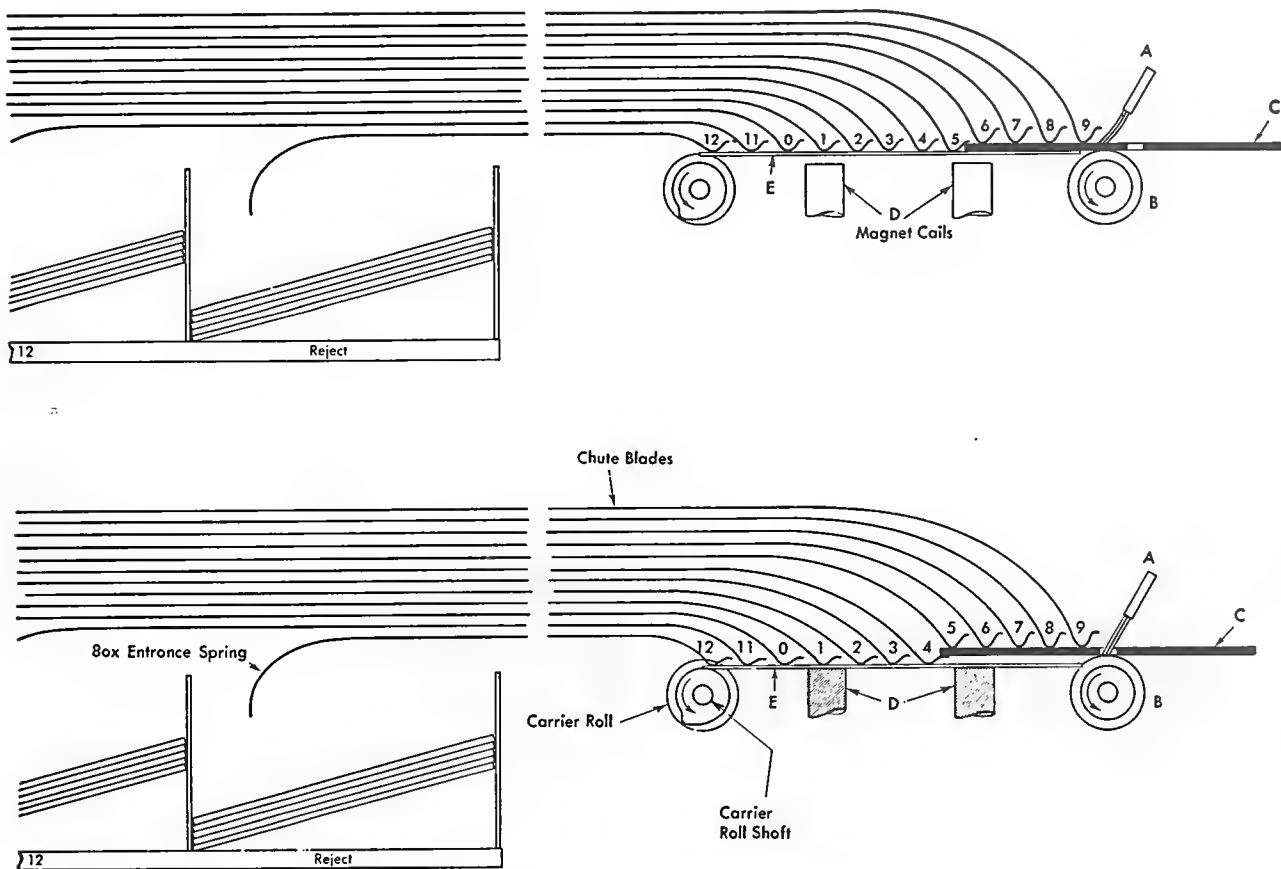


*Positioning cards for joggling*



Let us discuss the operating principle of the sorter to see how cards are directed into their

proper pockets. Figure 8 is a schematic diagram of the sorter's operating mechanism.



*Figure 8. Sorter Operating Principle*

In the diagram you see the sorter brush (A), the contact roller (B) and the card being sorted (C). Also illustrated are the sorter's magnets (D) and the sorter armature (E).

The card being sorted has the digit "4" punched in it. Notice in the upper diagram, the card is passing under the "chute blades" because the brush has not made contact with the roller. There is a "chute blade" for every pocket in the sorter. It is a strip of metal which begins at the front of the machine (as illustrated) and ends above its corresponding pocket.

In the lower diagram, the brush has dropped through the hole in the card and has made con-

tact with the contact roller. The electrical impulse which flows from the roller to the brush will energize the sorter magnets and pull the armature down. At the same time those remaining chute blades which the card has not passed under are also pulled down and one of them will "open" permitting the card to continue its path through the machine. Here the 4 chute blade will open. The card will enter it and from here be sent to the 4 pocket. After this card has entered the chute blade, the magnets will be de-energized and the armature will go up again. After the last card has been directed into its pocket, the machine will stop.



*Sight checking cards*

### 7.3 Card Handling and Checking

Before placing cards in the feed hopper, they must be "joggled". Joggling merely means to tap the cards so that they take on the appearance of a deck (the edges, top and bottom are square). Figure 9 illustrates how the cards are held while being "joggled." The cards are gripped very lightly by the right hand and tapped with the left hand until the deck is square. They will now feed properly.

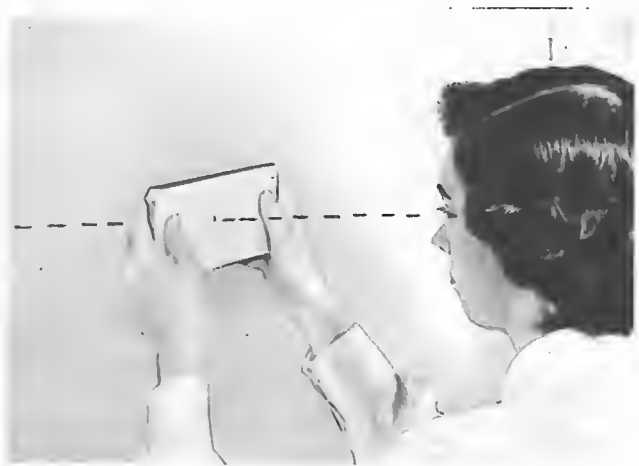


*Figure 9. Joggling Technique*

Cards are removed from the machine zero pocket first, then the one pocket, then the two pocket, etc. The one pocket is placed on top of the zero pocket; then the two pocket is placed on top of the one pocket, then the three pocket on top of the two pocket, etc. When you have finished taking the cards out of the sorter they will be face down and from bottom to top you will have the zero pocket, one, two, three, four, etc. They are then turned upside down so they are face up and they are then ready to be sorted on the next column.

During a sorting operation, it is necessary to check the functioning of the machine to see that the machine is operating properly. The most common method employed to check the sorter is the method called "sight checking."

For example, if you were sorting column 15, all cards which contain zeros in column 15 should fall in the zero pocket; all cards which contain a one in column 15 should fall in the one pocket, and so on. Each pocket is removed from the sorter in turn. The cards are joggled so that they are square, and then they are held up to the light. If the machine has worked correctly, light can be seen through the zone in the card being "sighted." An illustration of sight-checking is contained in Figure 10. If a card has been mis-sorted, it would block the path of light through the balance of the cards. It would then be taken out of the group manually and placed in its proper place.



*Figure 10. Sight Checking*



## 7.4 Numerical Sorting

As a practice exercise, let us take a group of cards which contain numerical punching and sort them into sequence. Figure 11 illustrates the

actual punches in the card as the cards lie in the feed hopper, and the three pockets which will be required to sort these cards.

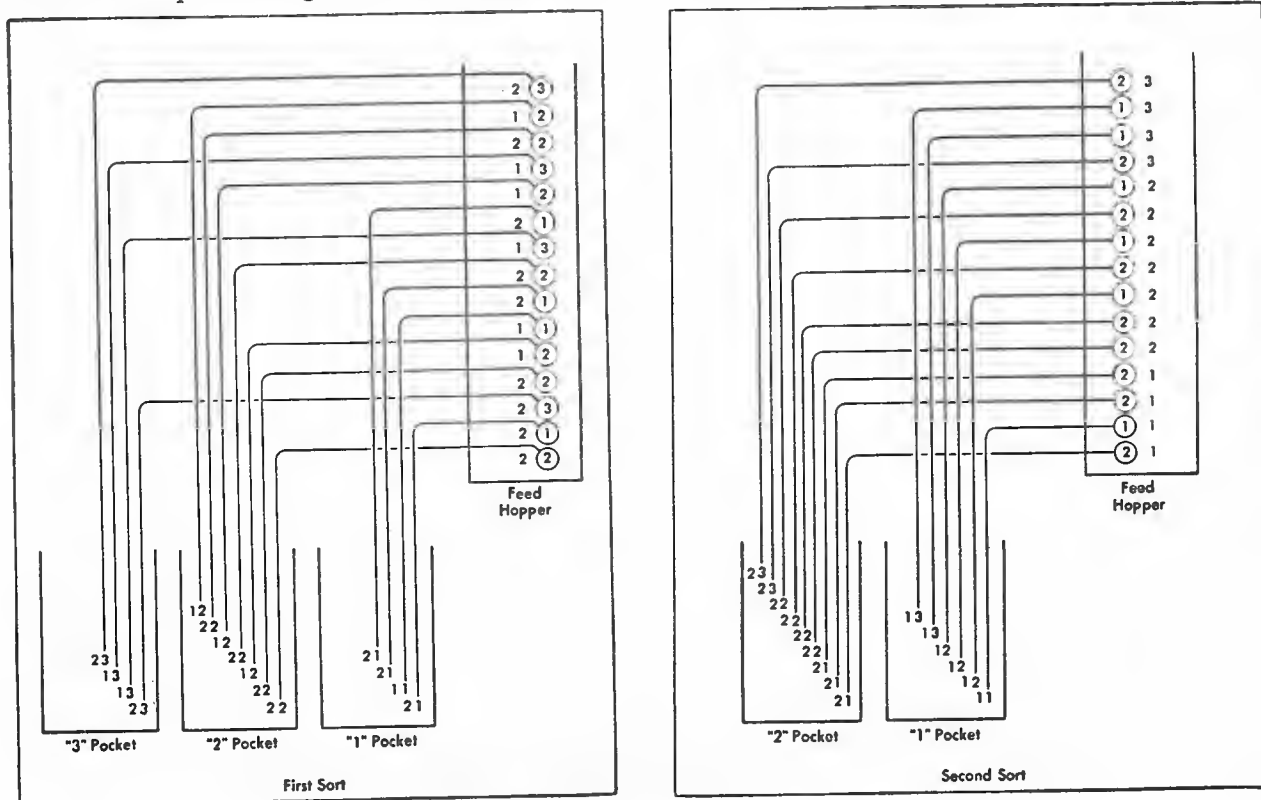


Figure 11. Sorting Exercise

- a) Before placing the cards in the feed hopper, they would be joggled so that they are square.
- b) The cards would be placed in the feed hopper.
- c) Assume that the cards are punched in c.c. 10-11. The first column to be sorted would be c.c. 11. The column indicator would be positioned at c.c. 11.
- d) The Start button would be pressed. After the last card has been processed, the machine would stop. The contents of the various pockets are illustrated in Figure 11 "First Sort", the left hand diagram.
- e) Notice that all the cards which contained a one in c.c. 11 are in the "1" pocket; all the cards which contained a two in c.c. 11 are in the "2" pocket; and all the cards which contained a three in c.c. 11 are in the "3" pocket.
- f) We now follow our rules for removing the cards: There are no cards in the zero pocket in this exercise, so we remove the cards from the one pocket first. We could at this point joggle the cards and sight-check them; we then remove the two pocket and place it on top of the cards which came out of the one pocket; we then remove the three pocket and place it on top of the other cards.
- g) The cards are then joggled and placed in the feed hopper. They appear in the feed hopper as illustrated in the right-hand portion of Figure 11.
- h) The column indicator is turned to c.c. 10 and the start key is pressed.
- i) After the last card has run through the machine, the sorter will stop. The contents of the various pockets are illustrated in Figure 11, "Second Sort", the right hand diagram. Of course, at this point the feed hopper is empty.
- j) The one pocket is taken out and sight-checked; then the two pocket is taken out and sight-checked and placed on top of the cards which came out of the one pocket.
- k) At this point, the cards are in sequence.
- l) Sorting speed of the 082 sorter—650 cards per minute.

The sorter is generally considered to be a very easy machine to operate. The important points to be remembered are:

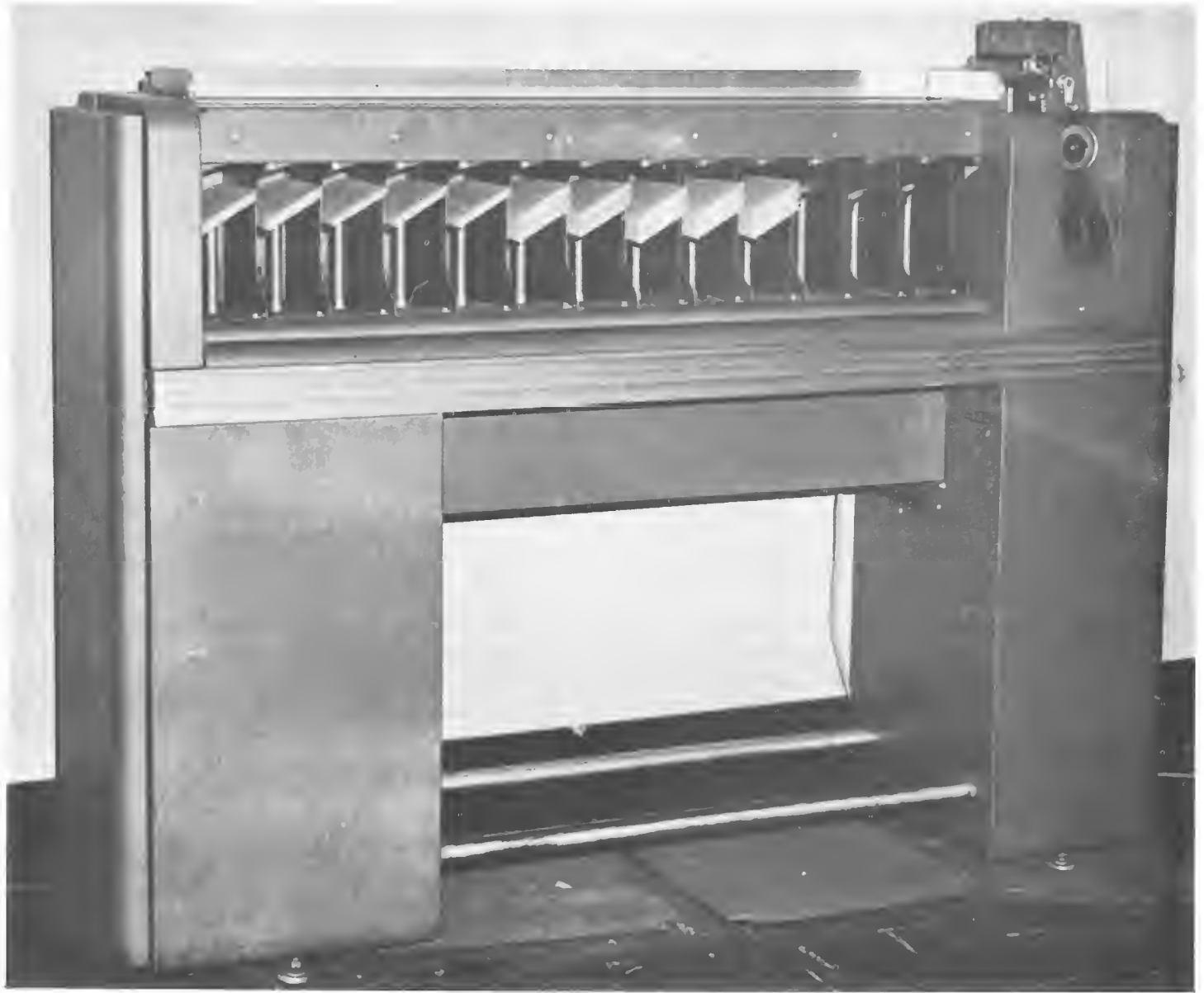
1. The units position of the field is sorted first, then the tens, then the hundreds, etc.
2. Cards are removed from the sorter zero pocket first, the one pocket on top of the zero pocket, the two pocket on top of the one pocket, etc.
3. Cards are always joggled before being placed in the feed hopper. This will insure proper feeding.
4. The column indicator is placed over the column to be sorted by turning the column-selector handle.

5. The cards must pass through the machine as many times as there are card columns in the field.

### 7.5 Selective Sorting

Selective sorting is used when we have a group of cards which are already in sequence and we desire to select from this group of cards certain special cards.

Assume that we have our 5000 Employee cards in sequence. (The employee card is illustrated in Figure 1). We decide that we want to select from this group of cards all employees who have a social security number ending in 5. How do the Selection Switches help us accomplish this objective?



First, we must understand how the Selection Switches operate. By pushing any of the twelve switches in towards the center of the ring, we prevent the brush from reading that corresponding punch. For example, should we push the pin corresponding to the "1" punch in towards the center of the ring, all cards which contain a "1" in the column being sorted will fall in the reject pocket as the "1" punch will not be read by the brush. In this instance, we want to select all cards with a 5 in the units position of social security number (column 32). If we push the "5" pin in, all cards with a "5" in column 32 will fall in the reject pocket — however, the rest of the cards will be sorted to all the other pockets and we would have disturbed their sequence. What then must be done? We push all the pins in towards the center of the ring EXCEPT the "5" pin. Now, the only punch the sorter will recognize is the "5" punch and it will direct those cards with a "5" in column 32 into the "5" pocket. All other cards will fall in the reject pocket.

Selecting cards which contain a special "x control punch" is the most common use of the selection switches. Assume that we have a group of cards in sequence from which we are to select

all cards which have an X in c.c. 79; the sequence of the balance of the cards is to remain undisturbed.

- a) Joggle the cards and place them in the feed hopper.
- b) Move the column indicator to c.c. 79.
- c) Push in towards the center the following pins: 12, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. The only pin not pushed in will be the 11 pin. This, of course, corresponds to the "x" punch.
- d) Press the start key. Those cards with an "X" punch in c.c. 79 will enter the 11 pocket; all other cards will enter the reject pocket.
- e) Always remember to push all the pins out away from the center of the ring when you have finished sorting.

### 7.6 Alphabetical Sorting

When sorting alphabetically punched cards, you must remember that each punched card contains two punches in the same column; the zone punch and the numeric punch. Therefore, to sort cards alphabetically, it will be necessary to sort each column *twice*, once numerically, and the second time to sort the zones (12, 11 & 0).

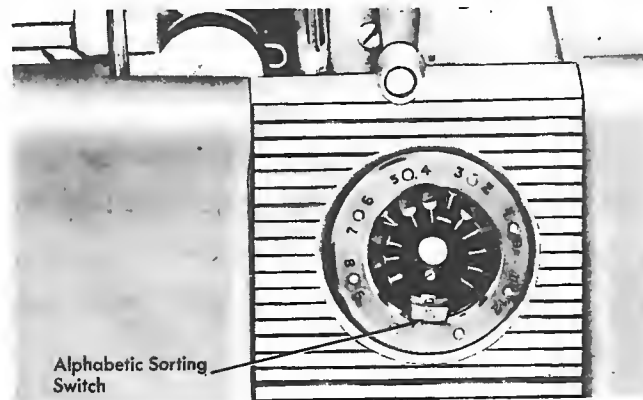


Figure 12. Selection Switches

Located on the selector switch ring is a pin called the Alphabetic Sorting Switch. It is the large pin in the center and bottom of the ring. When this pin is pushed in towards the center of the ring, it permits the sorter brush to recognize only the three zone punches.

Now, we have said that cards which are to be sorted alphabetically must be sorted twice on each alphabetic column, once numerically, and then the zone sort. Of course, we still sort the units position first. When the cards are going through the sorter for the numeric sort, even though there are two punches in the card column (one numeric, one zone), the sorter will recognize the first punch it reads. Since cards feed in 9 edge first,

the first punch to be sensed in an alphabetic character would be the numeric punch. Therefore, the cards would be sorted on the digit portion of the alphabetic character on the first sort. On the second sort, the Alphabetic Sorting switch would be pushed in and the cards would be sorted by their zone punches only. The 12 pocket will contain the letters A-I; the 11 pocket would contain the letters J-R; the 0 pocket would contain the letters S-Z.

The Alphabetic Sorting switch would be pushed out again and the next column would be sorted twice, first numerically and then alphabetically. This routine would be followed for each column in the field.

## SUMMARY

The 082 Sorter is used essentially to place IBM cards in sequence. We can sort cards into sequence numerically and also alphabetically. The method used for either is about the same except that alphabetic sorting requires us to sort each column twice. We also have a method of selecting

from a deck of cards those cards which contain special punches. This technique is most commonly used when we want to select from a deck of cards those cards which contain control punches without disturbing the sequence of all other cards.

## GLOSSARY

Many of the terms used in this lesson will be contained in prior glossaries. Review them should you be in doubt as to the meaning of a term or word.

*Alphabetical sort* — where a field contains any alphabetical characters at all, it must be sorted according to the rules that govern alphabetical sorting.

*Joggling* — the technique employed to "square" the cards before they are placed in the feed hopper. When properly juggled, cards are even at top and bottom and at the sides.

*Numerical sorting* — used for fields that contain digits only.

*Pocket* — One of the 13 collecting slots in the sorter. Pockets are identified by the punch they represent such as the 8 pocket, the 12 pocket, etc.

*Rejects* — those cards which are unpunched will be considered rejects. When sorted, they will fall in the reject pocket.

*Sequence* — cards are said to be in numeric sequence when the lowest number is in front and the remaining cards are higher or equal to their preceding cards. The highest number will be in the back. Alphabetic sequence means that the cards are in order A-Z.

*Sight check* — a means of checking the operation of the sorter. Cards are held up to the light and the operator can see through the deck at a particular zone and column.

*Sort Brush* — a device made of wire used to sense punches in cards by dropping through the punch to contact an electrical roll.



## EXAMINATION

INSTRUCTIONS: Your examinations are important to you as they indicate how well you understand the lesson material. Be sure to allow yourself enough time to complete the examination. Read each question carefully and be sure you understand it. Mark your answers in the proper box. Review the exam to be sure that all questions have been answered.

1. How many pockets are there in the 082 Sorter?
  - a. 12
  - b. 10
  - c. 13
  - d. 14
2. The 082 Sorter operates at the speed of
  - a. 100 cards per minute
  - b. 650 cards per minute
  - c. 500 cards per minute
  - d. 600 cards per minute
3. How many brushes are there in the Sorter?
  - a. 80
  - b. none
  - c. 1
  - d. all the above are incorrect
4. Cards are placed in the Sorter
  - a. Face down, 9 edge in.
  - b. Face up, 9 edge in.
  - c. Face up, 12 edge in.
  - d. Face down, 12 edge in.
5. The 082 Sorter can
  - a. Punch cards
  - b. Select "x" cards
  - c. Read and print cards.
  - d. Correct damaged cards.
6. For numerical sorting
  - a. All selector switches should be pushed in towards the center
  - b. Only the 11 & 12 switch should be pushed in towards the center
  - c. All selector switches should be pushed out away from the center.
  - d. All the above are incorrect.
7. To sort a field punched in c.c. 1-4
  - a. Sort c.c. 1 first, then c.c. 4, 3 & 2
  - b. Sort c.c. 4 first, then c.c. 1, 2 & 3
  - c. Sort c.c. 4 only
  - d. Sort c.c. 4 first, then 3, 2 & 1
8. Assume we have to sort an alphabetic field punched in c.c. 9-12. How many times will this deck pass through the sorter.
  - a. 4 times
  - b. 6 times
  - c. 8 times
  - d. all the above are incorrect.
9. Assume we have an item number field punched in c.c. 24-30. Which of these statements is False?
  - a. The first column to be sorted is c.c. 30.
  - b. The cards would be sorted 7 times.
  - c. The last column to be sorted is c.c. 24.
  - d. The Alphabetic Sorting Switch would be pushed in.

10. Which of the following statements is false.

- a. It is possible to select those cards which contain X control punches without disturbing the sequence of the balance of the cards.
- b. Cards should be juggled before being placed in the feed hopper.
- c. Cards are removed from the sorter and placed with the 1 pocket on top of the zero pocket, the 2 pocket on top of the 1 pocket, etc.
- d. The first sort on an alphabetic column is the zone sort.

Answer the following questions True or False.

If True mark an X in answer Box A; if False, mark an X in answer box B.

- 11. Those cards that are not punched in the column being sorted will fall in the reject pocket.
- 12. Only 1 column can be read at a time by the 082 Sorter brush.
- 13. When sorting an alphabetic field, each column is sorted twice.
- 14. The Alphabetic Sorting switch is pushed in for the zone sort.
- 15. To sort the field contained in c.c. 12-18 numerically, the cards would be passed through the sorter 14 times.

16. The sorter brush is moved by turning the Column-Selector handle.

17. Cards are in sequence when the highest number is in front and the lowest number in the back of the deck.

18. A card has both a "4" punch and a "12" punch. When sorted numerically, it will fall in the 4 pocket.

19. Cards which have been mis-sorted can be found by sight checking the sorter operation.

20. A card contains the letter T in c.c. 10; when this column is sorted with the Alphabetic Sorting switch IN, the card will fall in the "0" pocket.